International Journal of Inventive Engineering and Sciences (IJIES)
ISSN: 2319–9598, Volume-1, Issue-8, July 2013

Prototype Model of Multi-Load AGV for Material Supply in Manufacturing System

Rizawan N Shaikh,**Ramesh Kumar K.R**, **Ramachandra C.G**

Abstract –Here we aim to build a model of the multi load material supply system which is the hybrid of AGV(Automated guided vehicle) and AS/RS(Automated storage/Retrieval system) system. The AGV base provides movement in the manufacturing facility and AS/RS provides storage of the material. The machine can be designed depending on the AGV load caring capacity and variety of material need to be carried.

Depending upon number of variety of products and requirements, compartment can be increased or decreased. One of major advantage of this kind of machine in normal AGV is it has high throughput. Since single machine can carry more products hence number of AGVs needed to handle material is less thereby traffic in the manufacturing environment can be decreased and more efficiency in material handling transportation can be achieved. Due to decrease in AGV numbers in manufacturing environment, cost of handling and maintenance them is reduced hence it saves money and increase efficiency.

Keywords–Multi-load Robots, Multi Load AGVs, Revolutionary AGV Design.

I. INTRODUCTION

In normal manufacturing facility which use the AGV as material supply robot it is seen that AGV carry single material andit has to travel empty to the source once it transports the material to the destination. In some cases the material supplying AGV carries the load less than its capacity for single travelwhich decreases it throughput and also consumes the important productive time where AGV can be made to carry different variety of products in Flexible Manufacturing System it found that normally its full utilization of production system cannot be achieved. Hence more AGV robots need. As the more and more robot involve in supplying chain it lead to serious traffic issues.

AGVs are not only used for supplying the raw material but also to supply finished product to the warehouse. Once raw material loaded in to the machine is empty the empty compartment or chamber can be reused for placing the finished products. Hence there is aneed for the multi load material supply robot which can not only supply the material and also collect the finished material once they are processed. In some industries where products have to be assembled by the workers in the different work station, they are in need of some tools which need to be collected from the stores. In such case the worker need to stop the work and has to reach to the tool house to get required tool and come back to the his working station and use the tools. Once the work is completed theyhave to be placed back in the tool house and then return to assembly task.

Manuscript received on July, 2013.

Rizawan N Shaikh, M.Tech, Student, Srinivas Institute of Technology, Mangalore, India.

Ramesh Kumar K.R, Associate Professor, Srinivas Institute of Technology, Mangalore, India.

Ramachandra C.G, Associate Professor, Srinivas Institute of Technology, Mangalore, India.

The worker has to carry out such tasks repeatedly for assembling of complex machines. During these tasks valuable productive time is wasted. To avoid idle roaming time and to achieve full utilization of multi load AGV is a very important task.

II. LITERATURE SURVEY

There are many paper suggested multi load AGV design and structure as below

Automated Guided Vehicles (AGVs) have been operating effectively in factories for decades. These vehicles have successfully used strategies of deliberately structuring the environment and adapting the process to the automation.

In recent years, the automated material handling system has rapidly developed as an efficient manufacturing system. The AGV system plays a significant role and is widely used in modern manufacturing environments due to its flexibility and precision. With an AGV system, we can respond to changes in production volume, product mix, product routing and so on. However, due to the continuously increasing size and complexity of the modern manufacturing system, controlling this system has become more difficult [1].

In a warehouse, efficient product transportation is required for high productivity. In general, it is recognized that mixed-load transportation can decrease the moving time to some extent. However, many scheduling methods without regard to mixed-load transportation have recently been proposed [2].

In this paper, the pickup-dispatching problem of multiple-load AGVs (automated guided vehicles) is studied. Their control process identifies four problems faced by a multiple-load AGV. These problems are task-determination, delivery-dispatching, pickup-dispatching and load-selection. This paper focuses on the third problem. For this problem, nine pickup-dispatching rules are proposed and studied [3].

III. DESIGN

In multi-load AGV, horizontal AS/RS system is used for storing and retrieving of the material. This AS/RS (automatic storage and retrieval system) has four compartments to store the material which need to be carried to manufacturing machine and also a mechanism to push the product out of the multi-load AGV. This kind of the mechanism can also be in vertical fashion to carry high capacity of variety of materials in manufacturing environment. The white colour strip has been used to navigate the multi-load AGV in the environment

The AGV designed in this project is a 4 wheeled vehicle. In this vehicle, the DC motor crank wheel is given to a rear wheels which is located at back of the vehicle and the front wheel controlled by steering DC Motor of the vehicle. This crank wheel uses chain driven mechanism to supply power to vehicle.

The mechanism used in this vehicle is crank mechanism. There are 2 DC motors (0.5HP, 12V, 20amp) used which are interfaced with a circuit board, which provides the movement and steering drives. One motor is placed at the center, which controls the movement of AS/RS system. Another motor is located at the top of AGV to provide the push and retrieve movement. The front steering system consists of rack and pinion. The rack is welded to the shaft which connects the wheel and the pinion is connected to the motor by gear drives.

It has a simple design. The body of the vehicle is made out of steelalloy.AGV takes the input from the sensors placed at the front bottom side, left and right side of the vehicle. It also has IR(Infrared) lightwhich emits light to ground and sensor receives it. Center pair sensor IR input is used as the standard sample, and also to compare another two sensor input. Depending upon standard input generated by center sensor it is compared with left and right sensor to drive the AGV left or right. Sensor whose value is less than standard value drive motor front wheel in that direction. If the all 3 sensor value is equal then AGV moves in straight direction.

IV. HARDWARE REQUIREMENTS

A. *Transistor*

A transistor is a semiconductor device, commonly used as an amplifier. The transistor is the fundamental building block of the circuitry that governs the operation of computers, cellular phones and all other modern electronics.

Transistors amplify current, for example they can be used to amplify the small output current from a logic chip so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to amplify voltage. A transistor may be used as a switch (either fully on with maximum current, or fully off with no current) or as an amplifier (always partly on).

They are typically used in Mobile devices, gaming systems, Disk drive protection, Image stabilization, Sports and health devices applications.

B. *Resistor*

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law:

$$I = \frac{V}{R}$$

Where I is the current through the conductor in units of amperes, V is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms.

C. *Capacitor*

A capacitor is an electrical device that can store energy (like a battery but working is different way) in the electric field between a pair of closely-spaced conductors (called 'plates'). When voltage is applied to the capacitor, electric charges of equal magnitude, but opposite polarity, build up on each plate.

Capacitors are used in electrical circuits as energy-storage devices. They can also be used to differentiate between high-frequency and low-frequency signals and this makes them useful in electronic filters. Capacitors are occasionally referred to as condensers. This is now considered an antiquated term. They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge. They are used to smooth varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC (changing) signals but they block DC (constant) signals.

D. *Relays*

An electric motor converts electrical energy into mechanical energy. The reverse task of converting mechanical energy into electrical energy is accomplished by a generator or dynamo. Condition assessment of DC motors requires a basic understanding of the design and operating characteristics of the various types available: the series motor, the shunt motor, and the compound motor. Each type has unique operating characteristics and applications. These characteristics enable the operator to perform a wide variety of tasks.

DC motor fault zone analysis is a vital part of any DC motor maintenance program. Visual inspection and electrical testing of the armature and fields give the maintenance personnel an understanding of the condition of the motor. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

E. *Step Down transformers*

Transformer is a machine for increasing or decreasing the voltage of a discontinuous electric indicator. The transmission and supply of voltage over long distances will not be possible without this device.

Step down transformer is one of the main types that are being used to decrease the voltage. As the name indicates reducing the electric power is one of the main functions of this apparatus. For example: Suppose we are using a kind of product that requires only 110v but the main power diffusion is 220v, then it becomes mandatory for us to use a step down transformer. This is a machine whose secondary current is less than its primary current.

It can be said that a step down transformer changes electrical current from a higher level or phase configuration to a lower level. They involve several features like electrical isolation, voltage distribution and control. They are well planned and designed on the code of magnetic stimulation between coils to change voltage or current level. This type of device is deliberately designed to trim down the electrical energy from the main winding to the secondary winding.

F. *UM 606*

The UTC UM606, for a constant voltage/constant current mode SMPS (switch mode power supplies) application which is a highly integrated solution, it contains one 1.21V voltage reference with ±1% accuracy, one current sensing circuit and two operational amplifiers. The UTC UM606 is an ideal voltage controller for use in adapters and battery chargers because the voltage reference it's combining with one operational amplifier. And the UTC UM606 is an ideal current limiter for output low side current sensing because the other low voltage reference is combining with the other operational amplifier.

Features

- Constant voltage and constant current control.

- Precision internal voltage reference.
- Few external components.
- Easy compensation.

V. MECHANICAL PARTS DRAWING

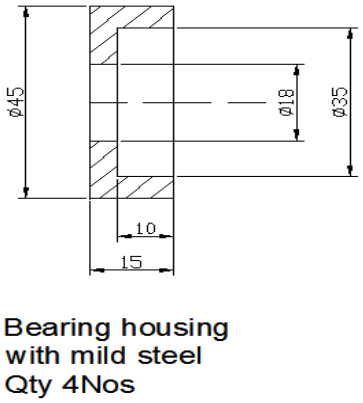


Figure 1: Bearing housing to Connect Bearing and Wheel.

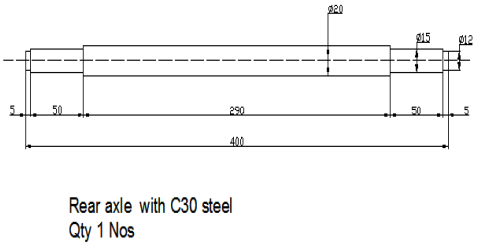


Figure 2: Step Down Transformers

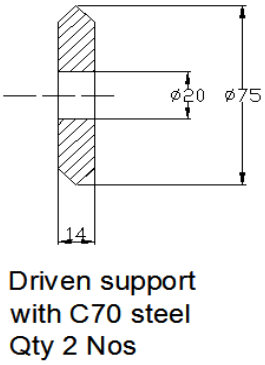


Figure 3: Step Down Transformers.

VI. CIRCUIT DIAGRAM FOR AGV CONTROL

A. Circuit to step down the voltage

This circuit consists of a step down transformer and a four-diode bridge. The step down transformer is used to step down the voltage from 230v to 15v. The four-diode bridge is required to convert the current from AC to DC. This output is given to the next circuit to perform the further process.

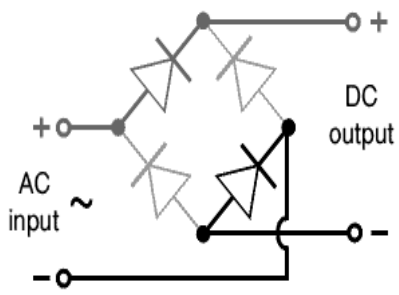


Figure 4: AC to DC Conversion.

B. Path Sensing And Moving

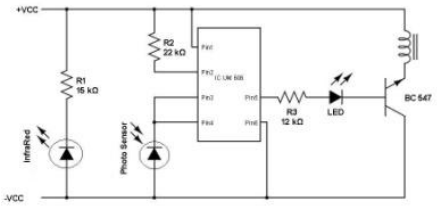


Figure 5: Circuit Diagram for Path Sensing and Moving.

C. Light Sensing And Stopping at Stop

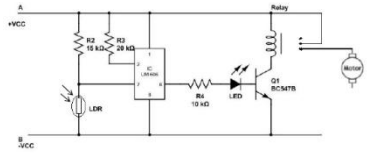


Figure 6: Sensing stop at station.

D. Rotary Stopping Circuit

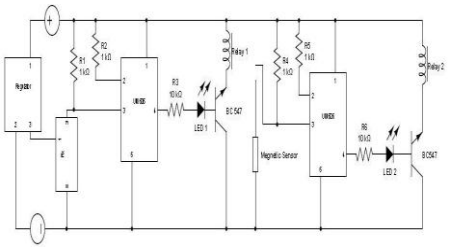


Figure 7: Stopping AS/RS Rotating System.

VII. WORKING IN MANUFACTUREING ENVIRONMENT

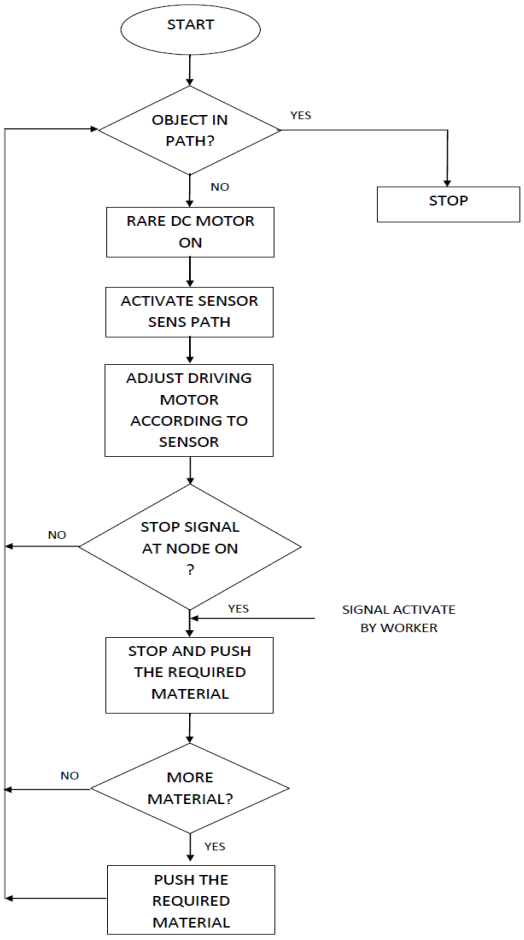


Figure 8: Algorithm Multi-Load AGV Working in Industries.

A. Results

Multi-load AGV step by step construction pictures shown below is shown below

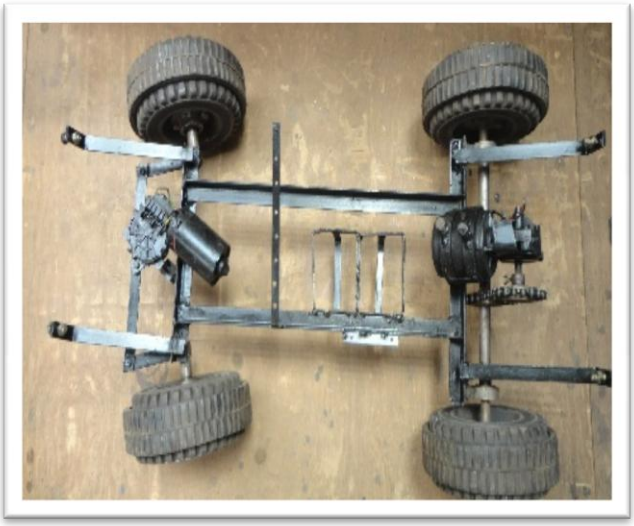


Figure 9: View of AGV Skeleton Model.

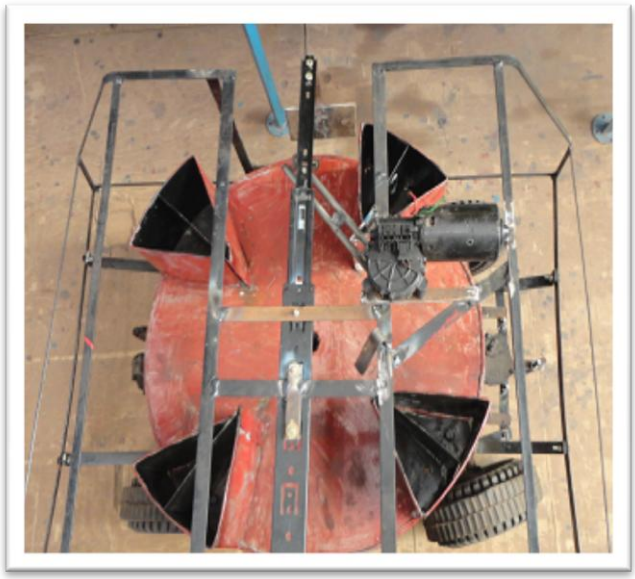
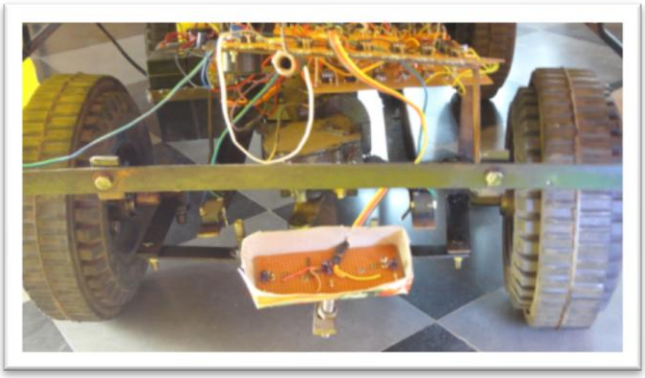


Figure 10: Top view of AS/RS system implemented.

Figure 11: Side View of Multi-load AGV with Rotary Mechanism.

Figure 12: User Module to Stop Multi-load and Retrieve Material.



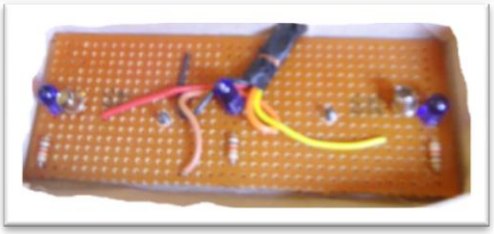


Figure 13: Front View of Multi-load AGV Path Sensor and Circuit.

B. Advantages

- Increase in man-hours and working.
- Reduction in inventory.
- Low life cycle operating costs.
- System operating flexibility.
- Useful in hazardous area.
- Reduction in downtime of machines.
- Work continuously.
- Improvement in industrial production and profit.
- Simplicity of implementation.
- Multiple Functions.
- Easy Maintenance.

VIII. CONCLUSIONS

Multi-load AGV help manufacturing industry in many different ways by reducing maintains cost, labor cost, power consumption. These reductions help in increasing production in the same production time. This kind of AGV is more appropriate to the fixed layout manufacturing, flexible manufacturing or job shop environment .This kind of AGV can be used outside the manufacturing system like hotel supplier robot or in the small workshops which contribute significantly to such problematic area. And also

manages the small industries where we find the shortage of labors to do repeated work. This AGV can do better than normal unit load AGV which is in use.

IX. ACKNOWLEDGMENT

The author wish to thank Dr. ShrinivasaMayya D, Principal andRamesh Kumar Associate Professor Dept. of Mechanical Engg, SIT, Mangalore, Prof. Ramachandra C.G, Associate Professor Dept. of Mechanical Engg, SIT, Mangalore for their moral support through the work.

REFERENCES

[1] D. VenkataRamanaiah, Ashok B, "*Performance Of Multi-Load Agv Systems Under Different Guide Path Configurations,"*International Journal of Technology and Engineering Sciences Vol.1 (1), ISSN: 2320-8007, 2012.

[2] Ryunosuke Takano, Toshimitsu Higashi, Hirofumi Tamura, Mingang Cheng, and Jun Ota, "*Mixed-load Transportation Scheduling in a Floor Warehouse Environment*," 2008 IEEE/RSJ International Conference on Intelligent Robots and Systems Acropolis Convention Center Nice, France, Sept, 22-26, 2008.

[3] Parham Azimi, HasanHaleh, andMehranAlidoost, "*The Selection of the Best Control Rule for a Multiple-Load AGV System Using Simulation and Fuzzy MADM in a Flexible Manufacturing System*," Hindawi Publishing Corporation Modelling and Simulation in Engineering Volume 2010, Article ID 821701, 11 pagesdoi:10.1155/2010/821701.

[4] SajjadYaghoubi, SanamKhalili, Reza Mohammad Nezhad, Mohammad Reza Kazemi&MahsaSakhaiifar,"*Designing And Methodology Of Automated Guided Vehicle Robots/ Self-Guided Vehiclesystems, Future Trends*", www.arpapress.com/Volumes/Vl13Issue1/IJRRAS_13_1_30,IJRRAS October 2012.

[5] ZhengYao,Grad. Sch. of Inf., Production & Syst., Waseda Univ., Kitakyushu, Japan, Fujimura, S. Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on Volume: 2 Date of Conference: 9-11 July 2010, Page(s) 255 – 259, Print ISBN: 978-1-4244-5537-9.