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Modification of Material Handling Process Using Automated Guided Vehicle (AGV)

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Abstract - *The main aim of this paper is to present a review of implementation of a modified material handling process using advanced PLC system. In olden days, industrial processes required a lot of human labor, resources, time and money. It was very difficult to carry out the processes like job handling and transportation. Another problem associated with this was the productivity and safety. With the development in microprocessor technologies, automation becomes the solution for a variety of problems associated with industrial processes. In the 20th century, Programmable Logic Controllers (PLC) using advanced microprocessor technologies were developed. This added as a fuel to the boom in automation industries.*

Key Words: PLC (Programmable Logic Controller), AGV (Automated Guided Vehicle), Colour and Proximity sensors, Crane mechanism

1. INTRODUCTION

The project that we have undertaken is to solve an industrial problem where previously relay based vehicle was used for material handling processes. This system had several issues like limited productivity, high maintenance , constant human intervention and most importantly safety hazards. The proposed scheme suggests automation and replacement of existing relay based system using PLC and advanced sensors. In addition to this an additional crane mechanism is to be incorporated at different work stations as and where required. The proposed system is expected to overcome all the limitations of existing system and after a longer life span.

2. LITERATURE SURVEY

The following literature was reviewed:
(i) Devendra Singh Yadav, Gaurav Singh Gurjar, Kunal Deo, Dheeraj Baghel, P.K. Pandey (2014), "A Survey Report on Automated Guided Vehicle using PLC1762 MICROLOGIX RS 1200 CPU", Proceedings of IRF International Conference,13th April-2014, Pune, India- From this paper, we have studied the basic architecture of system along with implementation strategies. It also provides information about the motion of vehicle and required software programming details. However, in the proposed system only the methodology is adopted and the equipments required are taken reference from CIS Catalogue.

(ii) Cummins India Ltd. Pune - CIS (Cummins India Standards) Catalogue as per revised year 2015- This catalogue is used for selection of different equipments in reference to the standard requirements of the industry (Spacicon Engineering Industries, Pune- 41).

(iii) Amit Kumar (2014), "Development of an Automated Guided Vehicles in Industrial Environment", IJMERR, Vol. 3, No. 1, January 2014 - Gives general idea and methodology of the same.

3. EXISTING SYSTEM FEATURES AND TECHNICAL SPECIFICATONS

- **Mechanical design-**
  (i) Material used- Mild steel for fabrication

  (ii) Weight handling capacity <2 tonnes

  (iii) Total system weight= Approximate 700 kg.

  (iv) Operating speed<=15kmph

- **Electrical design-**

Courtesy- Spacicon Engg. Industry, Pune

Fig. 3.1 Existing System

Sr. No.	Components	Specifications	Manufacturer
1.	Relay logic panel	8 channel, 24V DC operated	OMRON
2.	Steering and driving card	SD 2356	3M CONTROL
3.	Rechargeable Battery Bank	12V, 60 A/hr	LUMINOUS
4.	DC Series Motor	230V DC, 1 HP, 1500rpm(geared)	Techometric Control
5.	Sensors • Colour sensor (Black colour trace) • Proximity sensor	IP-67 (24V DC operated), sensing range- 40mm (24V DC operated), sensing range- 150mm	OMRON P&F
6.	Connecting cables	1.5 sq.mm for battery connection 0.5 sq.mm for onboard connection	POLYCAB
7.	Pendant Box (Forward push, Backward push, Emergency Stop)	3-way, 24V DC	TECHNIK

Courtesy- Spacicon Engg. Industries, Pune

Table 3.1 Electrical component specifications

The existing system uses relay panel for driving and steering of AGV. Whenever there is obstruction in its way, the alarm blows and indicators glow. To stop the AGV mechanical stopper is provided.

4. PROPOSED SYSTEM

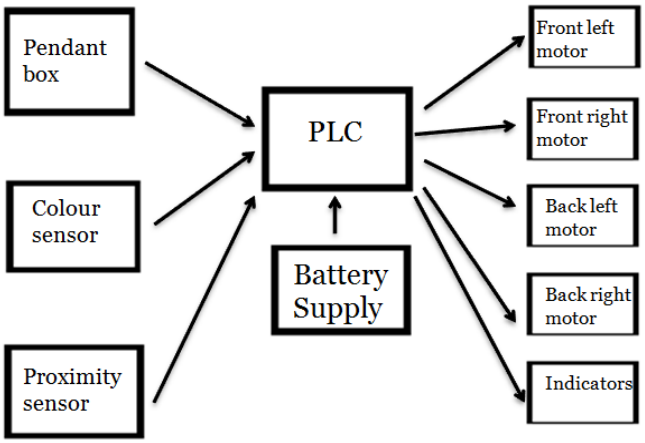

Fig. 4.1 Block Diagram of AGV

Automated guided vehicle (AGV) navigates using colour tracing. It uses two colour sensors mounted on the AGV to trace the colour path. Four motors are connected to four wheels of AGV. Based on the output of the colour sensors, the action of motors is programmed accordingly. To change the direction of the motion of AGV we can use a steering card. However, it is an expensive and complicated scheme. So, instead, we use the rear motors to change the directions of AGV. This can be done by simple process as follows: (i) Under normal operating condition (Straight path), all the four motors operate; (ii) When the AGV has to change its direction, we stop the rear motor on the opposite side of the colour sensor which deviates from its path thereby not sending any signal; (iii) For example, if the right side colour sensor deviates from its path and stops sending signal, then left side rear motor stops while the other three motors keep on working. This provides turning effect to the left side and vice versa.

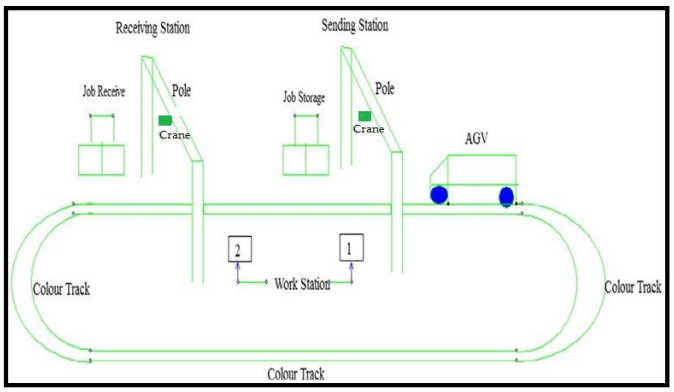

Fig. 4.2 Schematic diagram

As shown in the above fig. AGV travel on the designated colour path. There is one sending station and on receiving station. These stations use pick and place mechanism which has not been designed yet. The job is placed on the AGV and it travels on the path. Using proximity sensors, it stops at working station where a worker performs necessary action on the job. Once, the work is done, the worker presses the switch on the AGV and it moves ahead. This same process is repeated at each working station. The receiving station picks up the job and places into storage. The AGV then moves back to the sending station by tracing the colour path. The time required for one operation cycle depends on the number of workstations and the time required for each worker to perform the tasks.

The following table shows the list of components required for proposed AGV system:

Sr. No.	Particulars	Specifications	Qty	Manufacturer
1.	PLC	16 I/P, 16 O/P	1	MITSUBISHI
2.	Rechargeable Battery Bank	120 V , 60 Ampere/hour	2	LUMINOUS
3.	DC Motors	230V DC(Series), 1 HP, 1500rpm (geared)	4	Techometric Control
4.	Black colour sensors	IP-64, 24V DC, Sensing range<= 40mm	2	OMRON
5.	Proximity sensors	24V DC, Sensing range<= 150 mm	2	P & F
6.	Electrical Hooter	24V DC	1	Airtech
7.	Connecting Cables	0.5/1/1.5 sq.mm	1 set	POLYCAB

Source- As verified from CIS catalogue as per revised year 2015

Table 4.1 Components required for AGV

5. DESIGN OF CRANE MECHANISM AT WORK STATIONS

In the existing system, the crane mechanism which is used for loading and unloading of job has various safety related issues. The job oscillates during the crane's operation and it constantly involves at least two personnel for its controlling action. So, in the new system we are introducing an electric drive based crane which will be capable of safe operation. The motors used are DC series non-geared motors; one for horizontal and other for vertical motion. The horizontal action of the crane is first triggered by the proximity sensor which detects the arrival of AGV at the work station and then the vertical motion of crane takes place. A human personnel will hook the job to the crane which will then load/unload it.

Sr. No.	Particulars	Specifications	Qty	Manufacturer
1.	DC series motors	230 V, 1/2 HP, 1500rpm	2	Techometric Control
2.	Proximity Sensor	24 V , DC sensing range<=150mm	1	P&F

Table 5.1 Components of Crane Mechanism

REFERENCES

[1] Cummins India Ltd. Pune- CIS (Cummins India Standards) Catalogue as per revised year 2015

[2] Devendra Singh Yadav, Gaurav Singh Gurjar, Kunal Deo, Dheeraj Baghel, P.K. Pandey (2014), "A Survey Report on Automated Guided Vehicle using PLC1762 MICROLOGIX RS 1200 CPU", Proceedings of IRF International Conference, 13 th April-2014, Pune, India

[3] Amit Kumar (2014), "Development of an Automated Guided Vehicles in Industrial Environment", IJMERR, Vol. 3, No. 1, January 2014