# Desing And Automation of Assembly Line Using PLC

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***Abstract-*** *The Project deals with the transformation of assembly line in order to process the assembly of the parts of Steering system. The Design of assembly line is incorporated using CAD Software and the process is automated using plc and pneumatics. The implementation of design and PLC with interfaces needed is been implemented and the outcome so obtained after installation is reduction in time labor and aesthetics ergonomics are improved with quality assurance and major rejections from the customers are eliminated*

***Keywords***- PLC,CAD.

## I. INTRODUCTION

An assembly line is a manufacturing process (often called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from workstation to workstation where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled faster and with less labor. They are common methods of assembling complex items such as automobiles and other transportation equipment, household appliances and electronic goods. Assembly lines are designed for the sequential organization of workers, tools or machines, and parts. The motion of workers is minimized to the extent possible. All parts or assemblies are handled either by conveyors or motorized vehicles such as fork lifts, or gravity, with no manual trucking. Heavy lifting is done by machines such as overhead cranes or fork lifts. Each worker typically performs one simple operation.

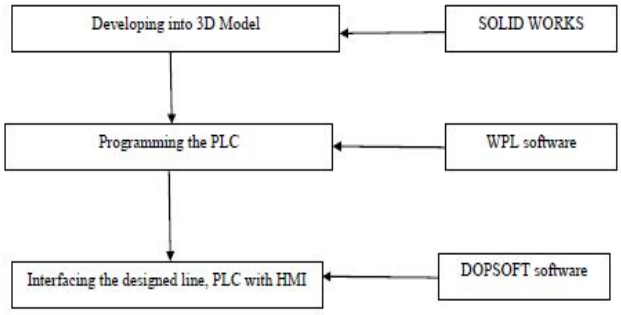
The principles of assembly are these:

- Place the tools and the men in the sequence of the operation so that each component part shall travel the least possible distance while in the process of finishing.
- Use work slides or some other form of carrier so that when a workman completes his operation, he drops the part always in the same place—which place must always be the most convenient place to his hand—and if possible have gravity carry the part to the next workman for his own.
- Use sliding assembling lines by which the parts to be assembled are delivered at convenient distances

Design decisions made early in the development process affect both ergonomics and productivity in the resulting system. While the time pattern of physical loading appeared to be controlled by flow and work organization elements, the amplitude of loading was determined more by workstation layout. Psychosocial conditions appear to be affected by a combination of system elements including layout, flow, and work organization elements. Strategic use of parallelization elements in assembly, perhaps in hybrid forms from configurations observed, appears to be a viable design option for improved performance by reducing the fragility and ergonomic problems of assembly lines. The interacting design elements pose potential of control by which productivity and ergonomics could be jointly optimized for improved total system performance.

## II. BLOCK DIAGRAM

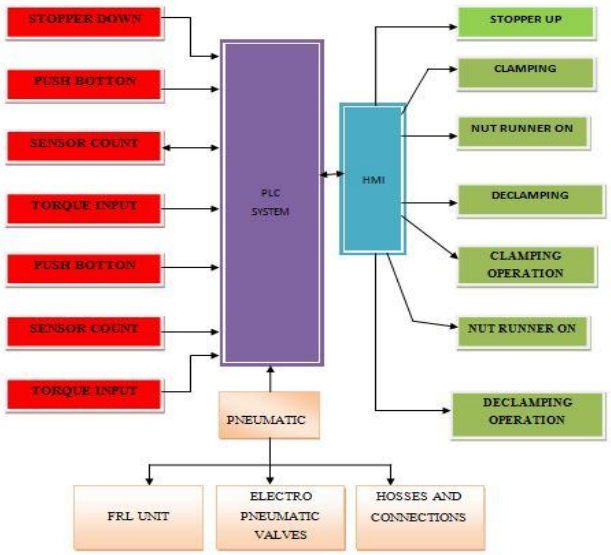
### A. Designing Assembly Line:




Block diagram 1

Fig 1: Block diagram showing the processes involved in assembly line

### B. ARCHITECTURE OF PLC INPUT AND OUTPUT




Block diagram 2

Fig 2: Block diagram showing the architecture of plc input and output

**C. Steering Systems**

The most conventional steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints (which may also be part of the collapsible steering column design), to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear–wheel steering. Tracked vehicles such as bulldozers and tanks usually employ differential steering — that is, the tracks are made to move at different speeds or even in opposite directions, using clutches and brakes, to bring about a change of course or direction.

The basic aim of steering is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of caster angle – each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centering towards the direction of travel.

The steering linkages connecting the steering box and the wheels usually conform to a variation of Ackermann steering geometry, to account for the fact that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, so that the degree of toe suitable for driving in a straight path is not suitable for turns. The angle the wheels make with the vertical plane also influences steering dynamics (see camber angle) as do the tires.

**1.2 Re-circulating ball steering gear**

Recirculating-ball steering is used on many trucks and SUVs today. The linkage that turns the wheels is slightly different than on a rack-and-pinion system.

The recirculating-ball steering gear contains a worm gear. You can image the gear in two parts. The first part is a block of metal with a threaded hole in it. This block has gear teeth cut into the outside of it, which engage a gear that moves the pitman arm (see diagram above). The steering wheel connects to a threaded rod, similar to a bolt, that sticks into the hole in the block. When the steering wheel turns, it turns the bolt. Instead of twisting further into the block the way a regular bolt would, this bolt is held fixed so that when it spins, it moves the block, which moves the gear that turns the wheels.

Instead of the bolt directly engaging the threads in the block, all of the threads are filled with ball bearings that recirculate through the gear as it turns. The balls actually serve two purposes: First, they reduce friction and wear in the gear; second, they reduce slop in the gear. Slop would be felt when you change the direction of the steering wheel -- without the balls in the steering gear, the teeth would come out of contact with each other for a moment, making the steering wheel feel loose.

**C. Delta series**

The 2nd generation DVP-SS2 series slim type PLC keeps the basic sequential control functions from the DVP-SS series PLC but with faster execution speed and enhanced real-time monitoring capability.

SPECIFICATIONS

- MPU points: 14 (8DI + 6DO)
- Max. I/O points: 494 (14 + 480)
- Program capacity: 8k steps
- COM port: Built-in RS-232 & RS-485 ports, compatible with Modbus ASCII/RTU protocol. Can be master or slave.
- High-Speed Pulse Output:Supports 4 points (Y0 ~ Y3) of independent high-speed (max. 10kHz) pulse output
- Supports PID Auto-tuning:DVP-SS2 saves parameters automatically after the PID auto temperature tuning is completed.
- Built-in High-Speed Counters

**D. Human Machine Interface HMI**

Human-machine interface (HMI) is a component of certain devices that are capable of handling human-machine interactions. The interface consists of hardware and software that allow user inputs to be translated as signals for machines that, in turn, provide the required result to the user. Human-machine interface technology has been used in different industries like electronics, entertainment, military, medical, etc. Human-machine interfaces help in integrating humans into complex technological systems. Human-machine interface is also known as man-machine interface (MMI), computer-human interface or human-computer interface.

In HMI, the interactions are basically of two types, i.e., human to machine and machine to human. Since HMI technology is ubiquitous, the interfaces involved can include motion sensors, keyboards and similar peripheral devices, speech-recognition interfaces and any other interaction in which information is exchanged using sight, sound, heat and other cognitive and physical modes are considered to be part of HMIs.

**E. LADDER LOGIC**

Ladder logic is a programming language that creates and represents a program through ladder diagrams that are based on circuit diagrams. It is mainly used in developing programs or software for programmable logic controllers (PLCs), which are used in industrial applications. The language evolved from originally being a method for documenting the design and construction of relay racks used in manufacturing and process control, with each relay rack represented by a symbol on the ladder diagram that has connections to devices below them that look like vertical rails. The relay symbols themselves look like rungs in a ladder.
Ladder logic is described as a rule-based language rather than a procedural or imperative one. Each "rung" in the ladder represents a rule, so when implemented to relays and various electromechanical devices, these rules execute simultaneously and immediately

**F. SENSORS:**

Range sensors are devices that capture the three-dimensional (3-D) structure of the world from the viewpoint of the sensor, usually measuring the depth to the nearest surfaces. These measurements could be at a single point, across a scanning plane, or a full image with depth measurements at every point. The benefits of this range data is that a robot can be reasonably certain where the real world is, relative to the sensor, thus allowing the robot to more reliably find navigable routes, avoid obstacles, grasp objects, act on industrial parts, etc.

## III. HARDWARE IMPLEMENTATION

**A. GUIDE TRACKS :**

Guide tracks are upheld on the help columns They are the L bars which keep running along a length of the mechanical production system for the seating and development of the directing rigging box.

**B. SUPPORT PILLARS.**

The support pillars are the base piece of sequential construction system, which gives inflexible help to the whole line. Guide tracks are bolstered on the help columns, These columns are secured to the ground.

**C. ACCESSORIES HOLDER:**

The.accessories.in the mechanical production system incorporate nut fastener and washers which are dumped in independent canisters to get to simple material dealing with. Indeed, even it holds the nut sprinter in each station. Short range sensors are put in each receptacle to get the correct check of particular nut and screw.

**D. HIEGHT SENSOR CASING:**

The packaging is welded to the guide tracks and the long range sensor is set in the packaging to pre characterized tallness This packaging holds a sensor which recognizes the external segment and signalizes the plc of its essence and nonattendance.

**E. HMI DISPLAY:**

The human machine interface show module shows the real activity of mechanical production system. The human friendly show conquers any hindrance amongst administrator and the framework. The touch screen show empowers for minor changes of task yet it watchword ensured.

**F. PNEUMATIC KIT**

The pneumatic pack so used to incite the pneumatic clasps has a unit of channel controller and lubricator unit alongside solenoid switches. The entire control activity of this unit is synchronized with PLC. The wire associations are done between plc pack and pneumatic pack where F-R-L unit is associated the compacted carrier.

**G. PNEUMATIC CLAMPS:**

The kind of brace utilized are the clevis compose, which has nylon covered finishes and these are settled to the guide tracks. These aides in cinching of apparatus box

**H. PLC KIT:**

The PLC KIT here utilized is a vigorous PLC KIT which is utilized to robotize the sequential construction system. The PLC utilized is a total pack of DELTA, which screens the entire working of the sequential construction system and is utilized to accomplish computerization (semi automation). The plc program has been investigated according to prerequisites of this venture with trail mistake and technique. The PLC is customized with stepping stool rationale with help of WPL programming, the finished program has been encouraged to DELTA PLC unit.

## IV. SOFTWARE IMPLEMENTATION

**A. WPL SOFTWARE(Programming PLC)**

WPLSoft is a program-editing software made for the Delta DVP-PLC series used under WINDOWS. Except for general program planning and other general functions (e.g. cut, paste, copy, multi-windows, etc.) of WINDOWS, WPLSoft, in addition, has provided various Chinese/English commentary-editing and other special functions (e.g. survey and edit the listed register, the setup, the data readout, the file saving, and monitor and set up diagrams of various contacts, etc.).

**B. DOPSOFT**

DOP-B series HMI is manufactured by adopting easy-to-use software and high-speed hardware to provide a powerful and stable programmable interface. Screen Editor software program is a user-friendly program editor of DOP-B series HMI for Windows. Please refer to the following section for an introduction to its features and functions.

## V. SEQUENCE OF OPERATION

**A. Station 1**

**Operation 1**

The Process begins with impelling crisis switch, the framework starts. At that point PLC signals the upward development of the plug. Presently the administrator puts the void apparatus box on the guide track and presses the push catch, bracing move makes put.

(Special case: To start the framework the pre essentials calls for crisis change to be in on position else the framework is dead. Once the cinching move makes put at that point push catch doesn't reacts to any arbitrary pushes until and except if it is held for stipulated time said in the program. This criteria is made just for crisis circumstances).

**Operation 2**

Once clamping is done, the administrator puts the external section over rigging box, because of this there will be breakage of nonstop shaft transmitted by the long range sensor. This signalizes the plc for the identification of external segment

**Operation 3:**

Next when the administrator gets the nut and screws the short range sensors settled at the embellishment holder checks the no of units lifted from the container particularly, Now the nut sprinter gets the flag and holds up the administrator to impel physically

(exemptions : if the administrator bungles the determination of indicated fasteners then the check from the sensor confuses the considers in the program an outcome the nut sprinter remains nil. )

**Operation 4:**

Presently the administrator activates the nut sprinter and affixes nut and screw to the external segment and checks the torque with the torque of each fastener and this flag is recorded by plc which declamps the apparatus box at station 1. The container is pushed to station 2 through guide tracks. The principle explanation behind utilizing torque is to apply determined torque on the latches

(Special case: The torque is observed by the torque if the flag is passed up a great opportunity the plc program doesn't enable the framework to declamp and furthermore the flag isn't created if the torque set doesn't coordinate with the torque on the nut connected.)

**B. Station 2**

**Operation 5**:

As he gets the rigging box from past station he incites push catch which does the cinching box. He adjusts the essential and auxiliary rocker shaft. Presently he applies Anna bond on to the cover plate and adheres it to adapt box

**Operation 6:**

At that point he attaches it utilizing nut and screw with help of nut sprinter. Toque is been checked by utilizing torque this flag is gotten by PLC and empowers de bracing. Presently the administrator pushes the gathered apparatus box for facilitate quality check

Exemptions: same as activity 4) (the primary explanation behind utilizing torque is to apply determined torque on the fasteners)Operators table:

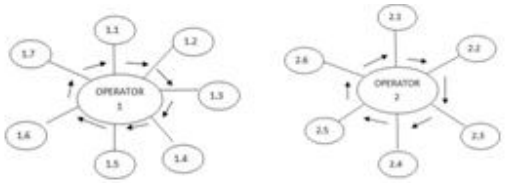
| SL NO | OPERATION NO | OPERATOR N0 |
|---|---|---|
| 1 | 1,2,3,4 | 1 |
| 2 | 5,6 | 2 |

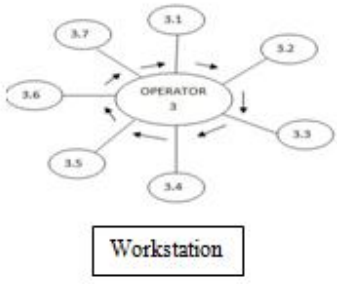
Table 1

## VI. RESULT

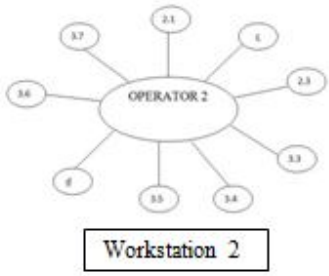
The demonstrated plans have been actualized for working of mechanical production system. The modified has been effectively mimicked and accumulated and has been fused to PLC HUMAN MACHINE INTERFACE is accomplished utilizing DOPSOFT and the show on the touch screen shows the work process and features which work is as of now going on

### A. OUTCOME OF TIME ANALYSIS




As a major aspect of automation it leads to adjustment and end of certain manual task and brought about decrease of time. Thus the work which was done by third was shared between administrator 1 and administrator 2. This caused evacuation of workstation 3 and administrator 3. Proof of this alteration is likewise appeared


## VII. CONCLUSIONS

This task is done to change over manual assembly framework to computerized assembly framework. To beat the principle purpose for rejection which was inappropriate torque on fasteners. By automating the assembly line this rejection of steering system was eliminated As the random operating system was turned into sequential system, it improved the Aesthetics and Ergonomic environment of the assembly line. Since Automation was fused it prompt change in process time, this prompt decrease underway time and diminishment of work from 3 administrators to 2 administrator. Since PLC administers the framework human mistake are inclined to be least.

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