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PLC Based Sub-Assembly Station with Automated Guided Vehicle

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Abstract:

The aim of the project is to build an assembly station with the preventive section under the process of poke yoke system. Poke yoke is the general methodology following in industry to avoid mismatching product in assembly stations. The main aim of this project is to avoid assembling process when the sequential procedure is not followed. The project also deals with AGV – Automatic Guided Vehicle. It automatically shifts the assembling components from store room to work station when the count of components decreases in storage bin. When the material count in the storage bins reaches the preset count it will pass signal to store room, the components will be filled manually in AGV storage bins and then the AGV is moved to the destination point (work station).

Keywords: Automated Guided Vehicle, Programmable Logic Controller, Human Machine Interface, Infrared and Light Emitting Diode.

I. INTRODUCTION

The main aim of this project is to avoid assembling process when the sequential procedure is not followed. The project also deals with AGV – Automatic Guided Vehicle. It automatically shifts the assembling components from store room to work station when the count of components decreases in storage bin. When the material count in the storage bins reaches the preset count it will pass signal to store room, the components will be filled manually in AGV storage bins and then the AGV is moved to the destination point (work station).

In the already existing system, the child parts may be missed due to human defects while assembling the product so there is a chance to not get assembled completely and reached the dispatch section, it requires reassembling takes more time to resolve the problem. If the incomplete product left out the industry it causes customers to dissatisfy on our products. The worker will not supervise the whether the sufficient material if there in storage bin or not and when it becomes empty the worker will take more time to refill the storage bins. Thus the work efficiency will be reduced.

It has some of the disadvantages like product mismatching, quality issues, material damages, production loss due to material transportation to overcome this disadvantages we are going to this proposed system.

In this proposed system, in this project we are going to develop the child part assembly station by **POKE YOKE** process by using PLC, MOTORS, and AGV CONTROLLER. In proposed system the above problems are overcomes by AGV and time gets saved. When the sensor in storage bin reaches the preset value it will send the command to the storage room that the storage bin is in need of materials to be filled. Man power in the storage room fills the required parts as per the command in the bin of automated guided vehicle. Our project overcomes the above stated problems by making automation process in assembling section and material movement. In this project the assembling process of the product get established in a pre-program sequential manner thus the assembling of any parts will not carried out without finishing the previous assembling so by this way the product get perfect completion. Thus no child parts are missed from assembling. The pre-program sequential manner is carried out by closing all the storage bins except the storage bin which has required parts. When the required parts are taken out from the storage bin, the storage bin gets closed and the next storage bin which carries the consecutive parts to assemble the will open automatically. Thus there is no chance of missing any parts. The storage bin closing and opening operations are executed with help of sensors and motor. The other parts of the project is that when the number of material get reduced in storage bin while assembling the parts it automatically get refilled by the material drawn from storage room through the AGV and the AGV gets controlled by through AGV CONTROLLER. It has some advantages like quality improved, production increase, and man power reduced.

II. BLOCK DIAGRAM EXPLANATION

An AC power supply typically takes the voltage from a wall outlet (mains supply) and lowest it to the desired voltage. Some purifying may take place as well. In modern use, AC power supplies can be divided into single phase and three phase systems. The primary difference between single phase and three phase AC power is the dependability of delivery. AC power Supplies can also be used to change the frequency as well as the voltage, they are often used by manufacturers to check the correctness of their products for use in other countries.

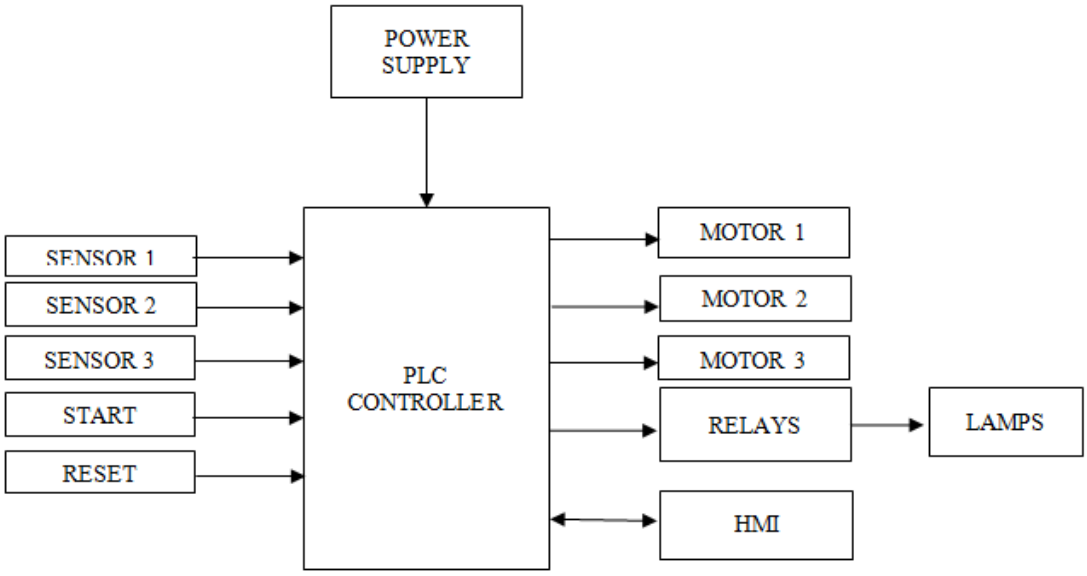

Figure 1 Sub-Assembly Station

A programmable logic controller (PLC), or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of developed processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process fault judgement. They were first developed in the automobile industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays and timers. Since then they take been widely adopted as high-reliability automation controllers suitable for harsh environments. A PLC is an example of a "hard" real-time system since output results must be formed in response to input conditions within a limited time, otherwise unintended operation will result.

Sensor is an object whose purpose is to detect events or changes in its environment, and then provide a equivalent output. A sensor is a type of transducer; sensors may provide various types of output, but typically use electrical or optical signals. It is used to count the material while in assembling process.

The DC motor is a device that transforms electrical energy into mechanical energy. The DC motor consist a rotating armature in the form of an electromagnet. A rotary switch known as commutator reversing the direction of the electric current double every cycle to flow through the armature so that the poles of the electromagnet push and pull beside the permanent magnets on the outside of the motor. The armature electromagnet passes the poles of the permanent magnets, meanwhile using the poles, the commutator reversing the polarity of the armature electromagnet during that instantaneous switch of polarity, inertia actuates the classical motor working in the proper direction. It can be used for shutter movement of material bin.

A relay is a electrically operated switch. Many relays use an electromagnet to mechanically activate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a path by a low-power signal (with complete electrical isolation between regulator and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers they frequent the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

The user interface, in the industrial design field of human–machine interaction, is the space where interactions between humans and machines happen. The goal of this interaction is to agree effective operation and control of the machine from the human end, whilst the machine simultaneously feeds back information that aids the operators' supervisory process. Examples of this broad impression of user interfaces include the interactive aspects of computer operating systems, hand tools, heavy operator controls, and process controls. The design considerations applicable when generating user interfaces are related to or involve such disciplines as ergonomics and psychology.

III. SWITCHED-MODE POWER SUPPLY

In a switching-mode power supply (SMPS), the AC mains input is directly corrected and then filtered to obtain a DC voltage. The resulting DC voltage is then switched on and off at a high frequency by electronic switch electrical system, thus producing an AC current that will pass through a high-frequency transformer or inductor. Switching occurs at a very high frequency (typically 10 kHz — 1 MHz), thus enabling the use of transformers and filter capacitors that are much smaller, lighter, and less expensive than those found in linear power supplies working at mains frequency. After the inductor or transformer secondary, the high frequency AC is corrected and filtered to produce the DC output voltage. If the SMPS uses an adequately insulated high-frequency transformer, the output will be electrically insulated from the mains; this feature is often essential for safety.

A DC power supply is one that supplies a constant DC voltage to its load. Depending on its plan, a DC power supply may be powered from a DC source or from an AC source such as the power mains.

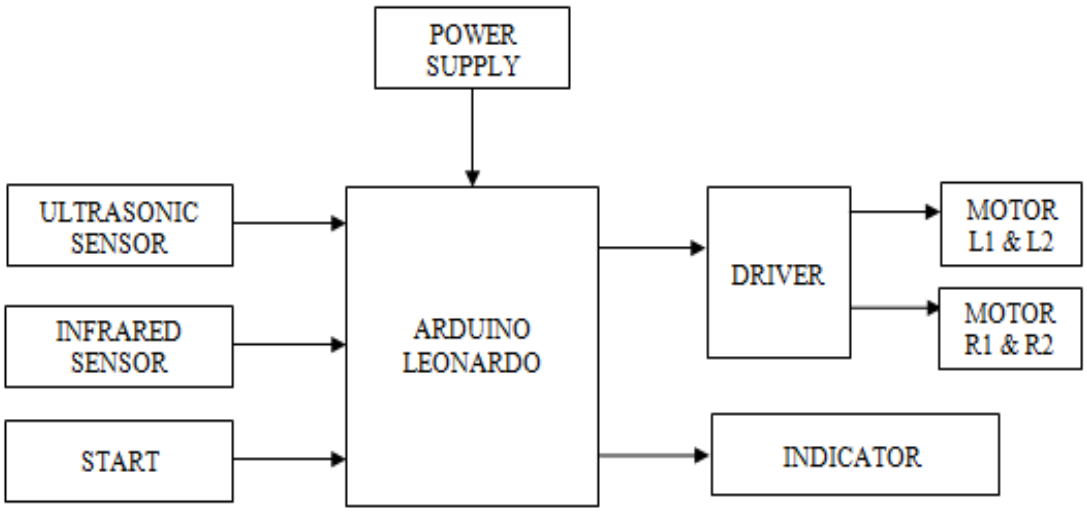

Figure 2 Automated Guided Vehicle

The Arduino Leonardo is a microcontroller board established on the ATmega32U4. It has 23 digital input/output pins (of which 7 can be used as PWM outputs and 12 can be used as analog inputs), a 16 MHz crystal, a USB connection, a power jack, an in-circuit system encoding (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer (or appropriate wall power adapter) with a Micro USB cable or control it with a AC-to-DC adapter or battery to get started (USB cable and power supply are not included). This board ships with the power jack and through-hole headers soldered. The Leonardo differs from all preceding Arduino boards in that the user-programmable ATmega32U4 AVR microcontroller has built-in USB functionality, removing the need for a secondary processor. This makes the Leonardo more versatile: in addition to supporting a virtual (CDC) serial/COM port interface, it can perform to a connected computer as a mouse and keyboard.

The DC motor is a device that converts electrical energy into mechanical energy. The DC motor consist a spinning armature in the form of an electromagnet. A rotary switch known as commutator reversing the direction of the electric current twice every cycle to flow through the armature so that the poles of the electromagnet thrust and pull against the permanent magnets on the outside of the motor. The armature electromagnet passes the poles of the permanent magnets, since using the poles, the commutator backing the polarity of the armature electromagnet through that instant switch of polarity, inertia actuates the classical motor going in the proper direction. It can be used for shutter movement of material bin.

Motor driver is a current enhancing device; it can also be act as switching device. Thus, after inserting motor driver among the motor and microcontroller. Motor driver attractive the input signals from microcontroller and generate corresponding output for motor.

This is a motor driver IC that can drive two motor simultaneously. Supply voltage (Vss) is the Voltage at which we demand to drive the motor. Generally, 6V for dc motor and 6 to 12V for gear motor are used, depending upon the rating of the motor. Logical Supply Voltage determining what value of input voltage should be considered as high or low .So if we set Logical Supply Voltage equals to +5V, then -0.3V to 1.5V will be considered as Input Low Voltage and 2.3V to 5V is taken into consider as Input High Voltage. L293D has 2 Channels .One channel is used for one motor.

•Channel 1-Pin1to 8
•Channel 2-Pin 9 to 16

Enable Pin is use to enable or to make a network active .Enable pin is also called as Chip Inhibit Pin.

•OUTPUT 1 (Pin No 3) --- It is the negative Terminal of Right Motor
•OUTPUT 2 (Pin No 6) ---It is the positive Terminal of Right Motor
•OUTPUT 3 (Pin No 10) --- It is the positive Terminal of Left Motor
•OUTPUT 4 (Pin No 14) --- It is the negative Terminal of Left Motor

The GH-311 ultrasonic Motion sensor provides specific, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It is very easy to connect to microcontrollers such as the BASIC Stamp®, SX or Propeller chip, demanding only one I/O pin. The GH-311 sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the eruption echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated. The GH-311 sensor has a male 3-pin heading used to supply ground, power (+5 VDC) and signal. The header may be plugged into a straight into solder less breadboard, or into a standard 3- wire extension cable

The IR Sensor-Single is a general purpose proximity sensor. The module consist of an IR emitter and IR receiver pair. The high precision IR receiver always detects an IR signal. The module contains of comparator IC. The output of sensor remains high if it is IR frequency and low else. The on-board LED indicator helps the user for checking status of the sensor without using any additional hardware. The power consumption in this module is low. Its output is digital in nature.

The sensitivity of the IR Sensor is tuned using the potentiometer. The potentiometer is tuneable in both the directions. Initially adjust the potentiometer in clockwise direction such that the Indicator LED starts glowing. Once that is achieved, turn the potentiometer just enough in anti-clockwise bearing to turn off the Indicator LED. At this point, the sensitivity of the receiver is at maximum.

IV. SIMULATION OUTPUT

HMI OUTPUTS

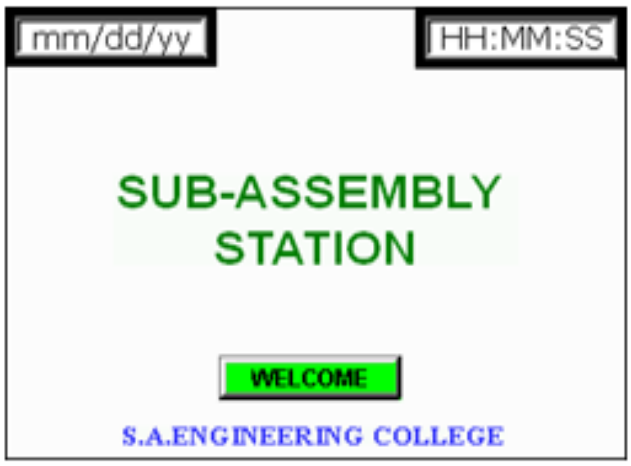

Figure 3 HMI welcome and title screen

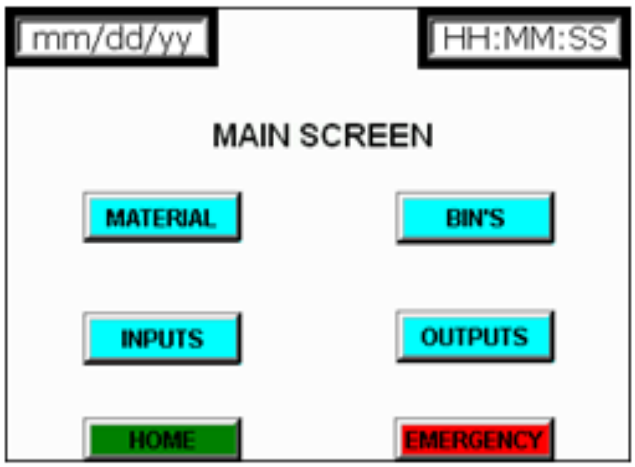

Figure 4 Selection of monitoring of output screen by using the main screen

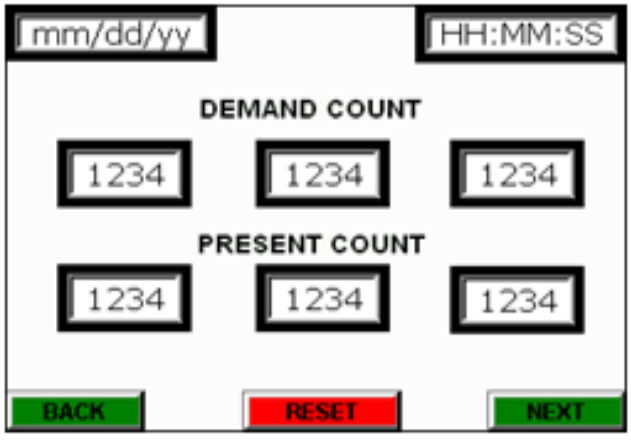

Figure 5 Level of material in the bins

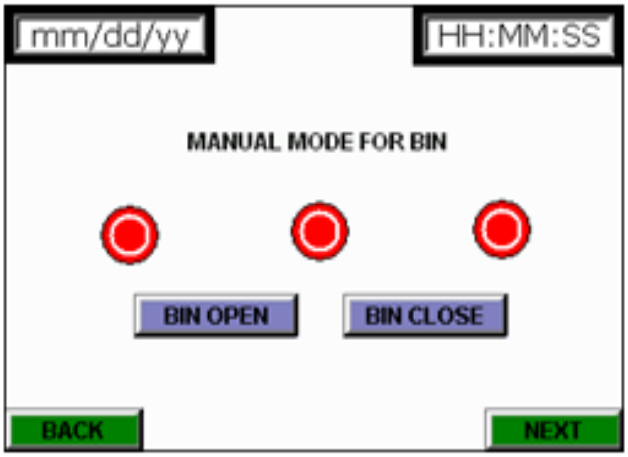

Figure 6 Processing Bin in HMI

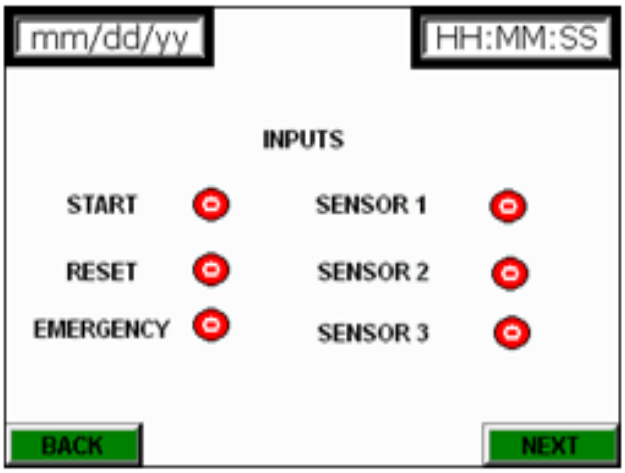

Figure 7 shows that working status of inputs in PLC by using HMI

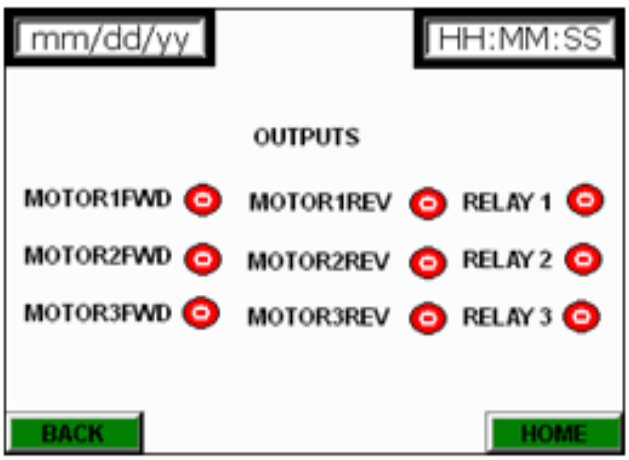

Figure 8 Working status of outputs in PLC by using HMI

V. CONCLUSION

The main aim of this work was create an automated assembly station by using the material counts in the storage bin which can be indicate the demand to the storage room by using PLC techniques. It can be increase the productivity, quality and reduce the time. Automated Guided vehicle generally referred as AGV was designed especially to introduce automation in all units of the factory. It is used to the material movement from store room to assembly station in Industry. By implementing AGV will lead us to the world of automation. Since there is no need driver (man power) to drive these kinds of Automated Guided Vehicle, the probability of error and carelessness in driving is reduced. We can expand this project in near future by implementing it in almost all industries. This new Automated Guided Vehicle will be used in Industries to make it fully automated to compete in this modern world of industries. This Automated Guided Vehicle will definitely reduce the material movement by manpower in Industries.

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