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MOBILE ROBOT PATH PLANNING VISION SYSTEM BASED END SEALING INSPECTION

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ABSTRACT

This project develops vision system-based end seal inspection of the soap for the manufacturing industries. The challenges in a manufacturing system are lack of timely, accurate, and lack of information to featured product prediction, product flow, product inspection, product quality. The proposed idea is to design Vision system-based End Sealing Inspection that creates a way towards progressively from traditional automation to enhance the quality of the product. The system utilizes the Vision camera and Industrial Controller to control the operation of individual systems and sequence of product flow in the Smart Factory setup. The vision system and automated platform enable the inspection of products shape, dimensions, sealing pack. The system transfers the product from section to section and finally to the packaging section. This digitization of manufacturing system increases flexibility, reliability, smart sensing and control, resource wastages; increase the quality of the product.

INTRODUCTION

1.1 INTRODUCTION

The smart factory, as one of the most important aspects of Industry 4.0, makes use of cutting-edge technology such as vision systems and automated machines to track physical processes in real time, store information, visualize through vision system, and make the correct decisions possible to increase the quality and the production. Individual systems in the manufacturing area can communicate and work with one another to make the optimal decisions possible. A sensor and vision camera is a device that connects computing devices to the manufacturing system in order to send and receive product quality data.

The smart system is integrated with the digitization of manufacturing processes, and statistics can be analysed based on the smart vision cameras information provided. The PLC connects with all other devices to share data and track and manage the process remotely. The Vision system technology provides a feature to access the stored data of captured manufactured products for the purpose of monitoring, analysing.

The entire system involved to carry out the process like, transfer of material through conveyors, vision inspection (size, shape, and defects), defected product separation, packaging. The inspected information can be monitored and data such as measurements, shape and type of defects can be stored in the smart camera's internal storage for an convenient access by the management and the In-charge

The controlling operation of triggering the camera using sensors input and controlling the Pneumatic system for ejection input terminal based on the PLC ladder logic program stored in the memory.

LITERATUE REVIEW

2.1 INTRODUCTION

In this modern world the automation are playing a major role in the field of technology. Automation is nothing but a machine which will perform more complex actions easier under human surveillance. Day by day it is improving to a greater extent and it is slowly replacing humans where they perform tasks which are repeated again and again. In many industries we can see automation process doing a major role in manufacturing products from starting till finishing.

1. Bandar Alghamdi, Dongbin Lee, Patrick Schaeffer, Joe Stuart who proposed a project titled the three frameworks to fill in as one completely incorporated computerized mechanical technology and assessment framework, using a 6-hub FANUC LR-Mate 200iC automated framework, a 2D-vision framework, and a transport framework. The subsequent framework will be assessed as far as quality, exactness, and accuracy. The undertaking will help distinguish abandons on an item that has been moved by a transport line and investigated by a 2D-vision framework associated with an automated arm, moving the item to the

right spot dependent on the consequences of the examination. Some portion of this cycle includes assessing 136-2 elements of individual items with the 2D-vision framework. Applying strengthening assessment measures, for example, a canvas investigation with a 3D vision frame work, could be a choice to recognize another sort of desert and improve the examination interaction.

2. G. Sujathaand V. Perasiriyan who proposed a project titled The cycle comprises of a belt transport driven by a little DC outfitted engine. The belt transports are mounted so that the article mounted on the principal transport will fall on the second transport. To detect the item five Infra-Red (IR) sensors are mounted at different focuses. To the end of the second transport an arranging plate with pneumatic actuators is mounted. The item can be arranged dependent on the tallness or length to Right or Middle or Left container. The arranging plate is isolated into three ways, Right, Middle and Left. Two wipers are fitted which are activated by pneumatic chambers. The Pneumatic chambers are constrained by solenoid valves. Every one of the information sources and yields are associated with 4mm attachments through which the entire framework can be controlled utilizing PLC or Microcontroller.
3. TadejPersak, BrankaViltuznik, JernejHernavs and Simon Klan cnik (2020) proposed ,"Vision-Based Sorting System", The conveyor belt that is used is transparent and machine vision camera technology and setup is used to detect passing products . A external bar light Illumination is used for the better lighting and the vision system incorporates industrial camera. Individual localization is done using Neighbours algorithm. After finding out each particle, they are separated using pneumatic air-filter system. They exhibit promising results and separation capabilities

HARDWARE DESIGN AND DESCRIPTION

3.1 VISION CAMERA

The In-Sight 7800 series is a full-featured, versatile vision device that inspects a wide variety of parts quickly and accurately across all industries. Its small footprint fits comfortably into production lines with limited room, and its unique, modular architecture is highly field-customizable to your application's needs. Alongside the interior and outside power/control lighting choices, the In-Sight 7800 arrangement additionally has a profoundly noticeable pass/fail LED marker light ring around the camera body, making it simple to view the assessment status regardless of where the framework is introduced.

The In-Sight 7800C (IS7800C) as shown in figure 3.1 with the resolution of 800*600 and with 0.5MP (Megapixel) this has frame rate 100fps (Frames per second) this vision sensor with an size of 1/1.8 inch. It is an global shutter type of sensor where this allows all the pixels to accumulate a charge with the exposure starting and ending at the same time and at the end of the exposure time the charge is read out simultaneously. So, the images has no motion blur on moving objects.

IN-SIGHT VISION SOFTWARE

An Software with an pre-programmed algorithm called In-Sight is given with camera for accessing and configuring the camera as per requirement. This software consist of many number of tools to inspect the part like Pattern Tool, Pixel count tool, Brightness tool, Edge tool etc.. These tools helps to find the part in the product and inspect as per programmed. This In-sight software is used for teaching the product through camera, where the correct or proper image is been captured and it is being taught to it. It compares or analyse the captured image with already taught image, then it takes the decision.

Figure : In-Sight Software

3.2 COMMUNICATION CABLE

The ethernet cable serves as a power source as a network link. The ethernet cable may be used to link a single device or a network switch can be used to connect several devices or an ethernet hub is being used for the distribution of communication within an system. An ethernet cable resembles a standard phone cable however is larger and has additional wires. each cables share an identical form and plug, however associate degree ethernet cable has eight wires, whereas phone cables have four. coaxial cable connectors also are larger. The Cat 5e and 6e are the ethernet cables are recommended for high speed communication between systems or within a system. This ethernet cable has different type of colour code which is of specific allocation of signals

3.3 POWER I/O CABLE

The breakout cable provides connection to an external power supply, the acquisition of trigger input, general purpose Inputs, High speed output and RS-232 serial communications as shown in figure 3.6. These provide an major power supply to the camera where the triggering control and the pulse from the controller is given through the power cable.

3.4 ETHERNET HUB

An Ethernet Hub contains of multiple ports which can be connected to additional network segments as shown in figure 3.8. These hubs support 10Mbps to 100Mbps of speed. This hub regenerates and transmits the data telegrams received to the remaining ports. The hub has a port assignment switch, and the transmit and receive cables are exchanged through an actuating switch that maintains polarity. When pocket arrives at one port it is copied to other ports so all the segments of the network, LAN can see all the data pockets.

3.5 SWITCHED MODE POWER SUPPLY (SMPS)

The switched mode power supply is a circuit which is mainly designed for obtaining the Direct Current (DC) voltage from an unregulated or unproper DC or AC voltage. There are four main types of SMPS like,

- DC to DC converter
- AC to DC converter
- Fly back converter
- Forward converter

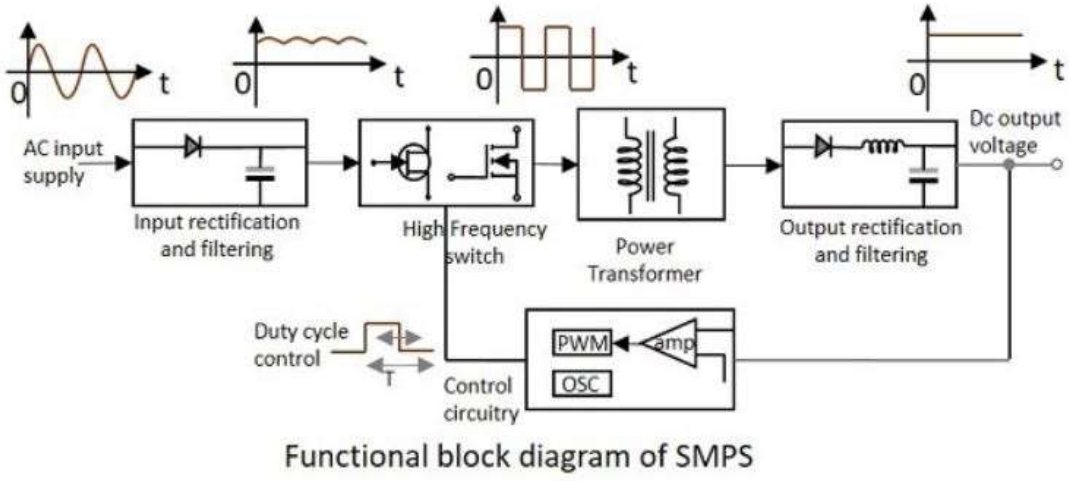


Figure : Functional block diagram of SMPS

The Switch mode power supply is generally used to indicate and generate the items which is been connected to the main or the external supply which an external power supply is being generated. The switch mode regulator is an circuit which is used for the regulation and the regulator is an essential part in the switch mode power supply. A controller is being controlling the regulator which will be true if current or voltage levels are high. A external series switching element is used because to able the higher current or voltage in a better handling.

3.6 C MOUNT LENS

The C Mount is a type lens mount commonly used and found in machine vision camera's it is of 20mm which is widely used in industrial digital cameras. The C mount lenses have a male thread which mates with a female thread on the camera. The C mount is of standard electrically focus tuneable lens and it is compatible with standard industrial cameras.

The lens resolution helps to determine the large pixels in order to resolve them. When combined with positive power offset lens the tuneable lens can achieve short focal lengths and can be used directly with standard industrial cameras. With a negative power offset lens, the tuneable lens can achieve placing in front of optical components as a close – lens for fixed length lenses.

3.7 EXTERNAL LIGHT

The lighting is one of the most critical aspects of machine vision applications. Failure to properly illuminate a target may result within the loss of data and productivity. A lighting technique involves a light-weight supply and its placement with relevance the half and therefore the camera.

Proteus Comet series bar light has been used to illuminate equal lighting for all sides of inspection part. These bar lighting provides a strip of light on the target or in along edges of the target part or part to be inspected for uniform illumination along the localized area.

3.8 MOTOR & GEAR BOX

A 3phase induction motor of Transtech gear brand is been used. This motor is suitable for 415 Voltage at frequency of 50Hz and 1.1 Ampere with star connection and the motor is suitable for 240V at the frequency of 50Hz and 1.6 Ampere with 3 phase in delta connection. This is can run in rate of 1400 RPM

Figure : Motor Name Plate

3.9 PROGRAMMABLE LOGIC CONTROLLER (PLC)

The Programmable logic control is a type of an digital computer which plays an major role in automation and ruling of electromechanical processes like controlling many numbers or multiple machines with a single controlling unit. These PLC are segregated as two types in input and also in output

- Analog - Input & Output
- Digital – Input & Output

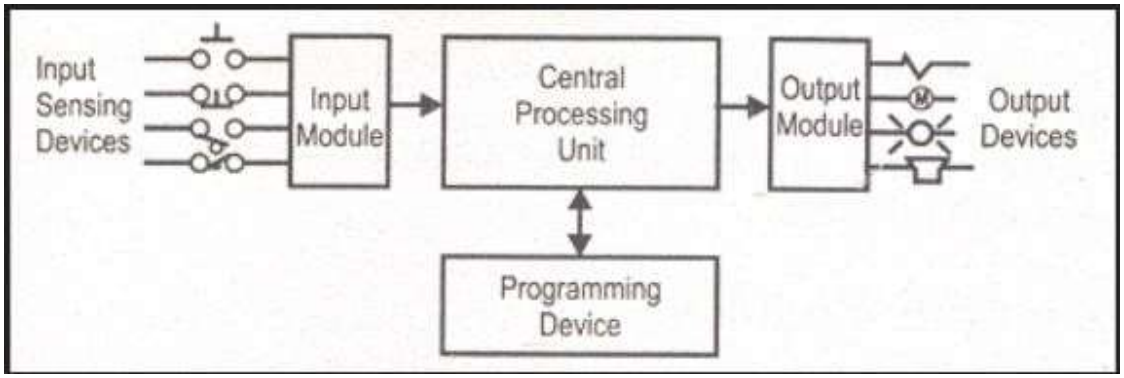


Figure : Block diagram of PLC

PLC is a specialized and super-computer made to control the machine and the process of the system. There are three core parts of PLC is Power supply, Centralized process unit and Input/Output ports. The power supply of 24VDC which is needed to actuate the PLC is being supplied from the switch mode power supply and it provides an regulated voltage source. The main part of three

segregated is Central Processing Unit (CPU) which is the brain of the PLC which is of microprocessor, memory chip, monitoring and communication. There are different types of modes in PLC such as run mode, stop mode, load, download. Programming mode which allows the program or the logic to download from the Personal computer as per programmed in sequence. The Run mode is which a PLC is which operates in sequence of operation in a desired.

4.4 FLOWCHART

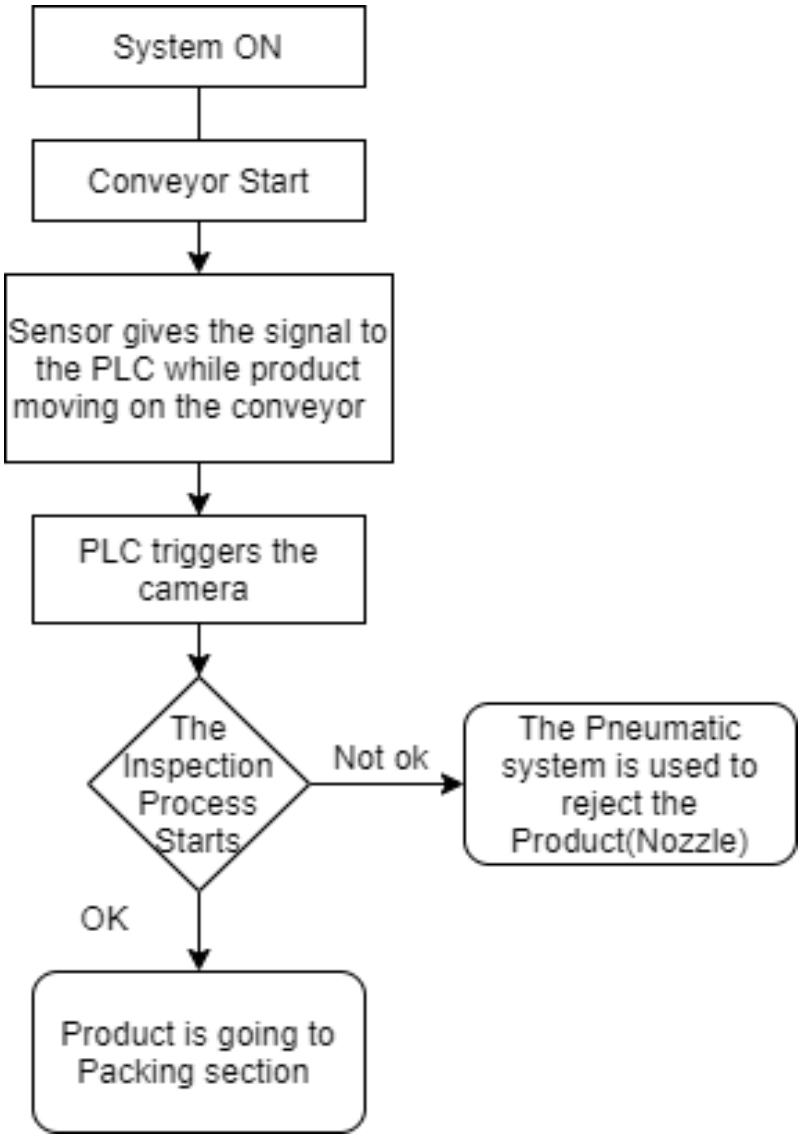


Figure :Flowchart

4.5 PROPOSED METHODOLOGY

The conceptual design depicts that the soap with different specification details like size, shape, dimensions and variant through the vision tool in system. The product is been feed in to the conveyor which it is an continuous cycle process where the product from the various section manufacturing is finally for quality inspection by the vision system installed in the moving conveyor system. The capturing of data is for the purpose of analysing. After the product feed in to the conveyor, then transferred by the moving belt. When the conveyor receives product and starts moving to the inspection section after the photoelectric sensor senses the availability of product. Then the sensor gives pulse to controller and the receiving signal from the sensor triggers the camera for capturing the product for the further inspection. Further the inspection section for identifying the soapsize, shape, dimensions, variant and defects takes place in smart vision camera placed in the conveyor. The perfectly packed product will alone travel to the packaging section.

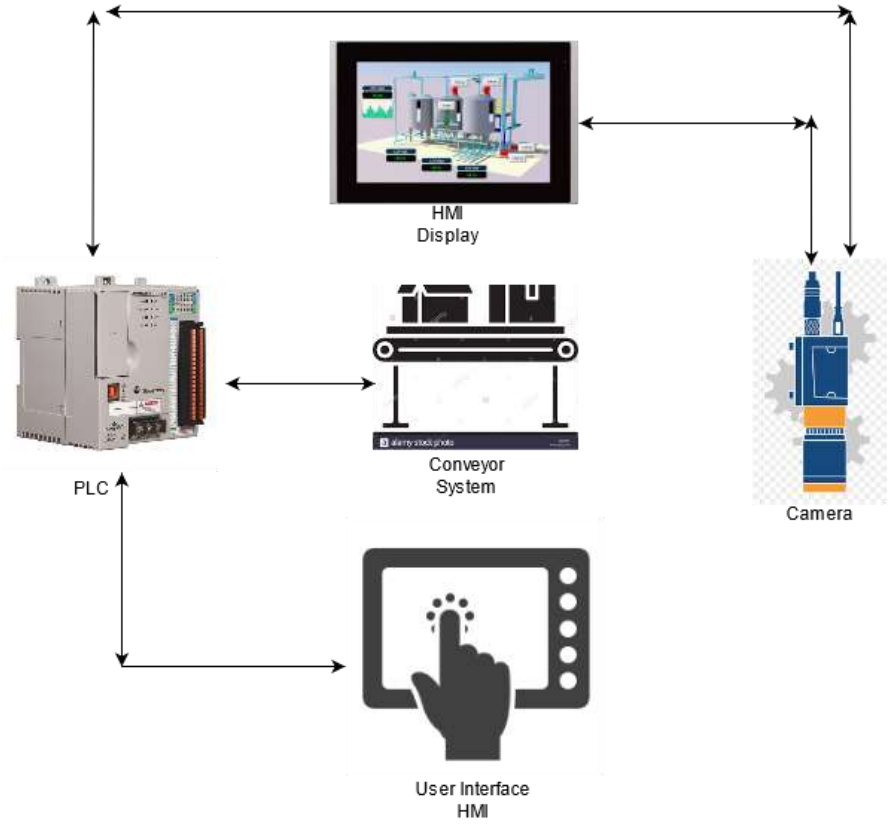
Progress of the system structure

i) Feeding section

ii) Inspection section

iii) Pneumatic Ejection section

iv) Final packing conveyor section



4.6 WORKING

Step 1:

Feeding section

The Conveyor system has been developed for the purpose of transferringthe soap from one section to another section. Feeder unit is an conveyor. This is driven by an AC induction motor and controlled using Allen-Bradley Powerflex 523 VFD drive. An Smart vison camera is placed in the top of the Conveyor for the inspection process. An pneumatic system with FRL unit is used for ejection. An reservoir is placed for an constant ejection of air at 6 bar.

An high efficiency narrow air nozzle is used for the rejection of product. The controller gives pulse to solenoid valve for the actuation of air ejection. Conveyor transfers the partreaching to the section is been done by the Photoelectric sensor. Then PLC triggers the I/Os.

Figure :Feeding Section

Step 2:

Inspection section

Once the soap reaches inspection section, the visions system ensures the inspection of shape, variant and dimension, packing quality of the soap. If a soap does not have any defect, it will go automatically to packing process. If a soap has defect in packing, then the vision system I/O will send the data of the defected soap, If the soap is met with the defect then the controller is programmed and instructed to actuate the Pneumatic ejection system and the defected soap is being separated using the air ejection and it is been recycled for the better product.

Figure Camera Inspection Section

Figure Camera Inspected Product in HMI Display

Step 3:

Pneumatic ejection section

The inspection is done by the smart vision camera and the analysing process is done. If the product is good with null defect it travels towards the final packing. Otherwise if a defected product is found, the vision system sends and pulse to controller and it react by giving pulse to solenoid valve placed in the pneumatic system, and then it triggers the air with efficient level to eject the product from the running conveyor to the ejection bin.

The ejection bin is used to collect the defected product and its level is being measured using a sensor. If the bin reaches its limit, then it gives a buzzer sound to clear it. That product is being drawn back to recycling process.

Figure Conveyor with Pneumatic Ejection System

Step 4:

Final Packing Conveyor section

The Conveyor has transfers the soap from one section to another section where after the final inspection of the product with perfect quality reaches the final packing section of process. These products are grouped as per categories and packed sequentially.

These finally packed is filled with perfect quality of the product it is been delivered to the customers and vendors.

Figure : Conveyor to Final Packing section

RESULT AND DISCUSSION

The system is designed with fully automated using the PLC(programmable logic controller) which takes care of the control towards corresponding section shown. It senses the flow of material in the conveyor by using the photoelectric sensor. The data from the vision system captures and identifies the defective packed soap, and this information is sent to the controller, which diagnoses the problem and corrects the imperfectly packed soap by reviewing the previous process data from the vision system.The HMI shows data on the production status, such as the number of products completed over time, defective products, and shift details Based on this data, management can concentrate on business planning and quality output without any problems.

CONCLUSION

This paper creates novel layout its enables process of monitoring and analysing the product through an automation vision system. There is the major drawback in the basis of quality analysis in most of the products, because a manual work is being done in the field of quality inspection. These manual inspections will not meet the 100% in the basis of quality checking, If human works there will be an huge chances of error occurring. To overcome these types of errors and issues in the basis of quality a smart way of using a vision system is better to avoid those issues. Cameras are used to inspect the products where an accurate level of quality will be the outcome. This vision system is being interfaced with PLC and it acts accordingly as programmed. The system's potential reach includes the implementation and interconnection of IIoT for product manufacturing.

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