International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 05,
2019 ISSN: 1475-7192

Implementation of SCADA in Cartoner Machine

[1]Hara Prasad Tripathy, [2]Priyabrata Pattanaik,

Abstract--- *this paper proposes the implementation of SCADA for using visual basic in a cartoner packaging machine for a variety of reasons. A very less number of parameters of an input user are required by SCADA applications and data monitoring, logging and functionalities that are to be visualised by a user. Most of the functionality is provided by SCADA based solutions but at a cost higher than that for OEM customers. SCADA applications and industrial HMI are created by OEMs, users, integrators and developers visualized by a user. The view of industrial process in real time commensurate SCADA based on VB, downtime is reduced and also the troubleshooting time for faults are reduced. The visualization gets easier when OEM industries adapt to customized SCADA.*

Index Terms--- visual basic, SCADA, Delta PLC, packaging machine, Modbus.dll.

I. INTRODUTION

The application of PLC has expanded nowadays in automation industry. The quality and production of product is increased by the use of PLC as a controller of machine in assembly lines of production. However, unpredictable occurrence can arise with the advancement in technology. Where the most undesirable happening could be a machine breakdown. The production will be affected by the length of breakdown. The period of downtime is reduced by showing a PLC or machine process for seeing the situations of breakdown easily. The display of process of PLC is used by a diagram of PLC ladder [1]. However, the ladder program display is not systematic, rather complex. However, a GUI is designed which is appropriate for replacing the display of a ladder diagram. Also, the process of troubleshooting and reconfiguring are facilitated by this. This condition leads to the decrease in duration of breakdown and improvement in production [2]. The industrial processes are interacted by following two approaches by industrial engineers via a universally known solid state device also known as “programmable logic controllers (PLCs)”. They are capable of utilizing a “pre-programmed human machine interface (HMI)” and also capable of customizing their solution. Due to lack of visibility of complicated tasks before users, developers find HMI software packages appealing to them. Debugging is an easy task as the licences are purchased for development and software are run from a local distributor who is authorized and it is installed into development of PC and then configuration is done [8]. Later on, compulsory runtime applications are deployed, executed and configured files on PCs. The changing behaviour and environment of each vendor of HMI software varies and similar tasks are accomplished by specialized skills. Exclusive network channels of a distributor are needed for delivering communication protocols, software for programming and

Department of Engineering, Siksha ‘O’ Anusandhan (Deemed to be University), Bhubaneswar,
haraprasadtripathy@soa.ac.in, priyabratapattanaik@soa.ac.in

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

material costs by HMI vendors [2]. It is a big issue to implement SCADA for multiple deployments. An additional payment is required for software licences before deploying solution to portable devices, PCs and web servers. The assistance of a user in maintaining and running a machine and management of industrial process is the chief aim of a SCADA system. The machine's productivity will be increased by good SCADA system, downtime will be reduced and good quality products will be provided. The complexity and production of product by category of machinery used will change the functionality of SCADA [3]. The inclusions of a functionality are:

- Existence of link of communication between PC and PLC.
- Archived Data and Real Time are trending by visual HMI [3].

The industrial applications find many advantages of using HMI/SCADA as visual basic. The biggest advantage is it is capable of providing optimal solution for development of applications of HMI and SCADA. There is no fees of runtime and royalties as well. The costly software of automation are provided with visual basic having industrial connections. The widely used environment for development is visual basic and the appeal of well supported, cheap and large base of developer is attained by visual basic [4]–[6].

II. INTERFACING METHOD

This paper proposes a block diagram of the architecture of a system, and there is server computer and a controller PLC [7]. A "RS-232C serial Modbus communication Link" is used for connecting PLC to server. A Ladder logic is realized by PLC for implementation of functions of industrial logic while a software which is loaded in a server computer is used for interfacing with user [8].

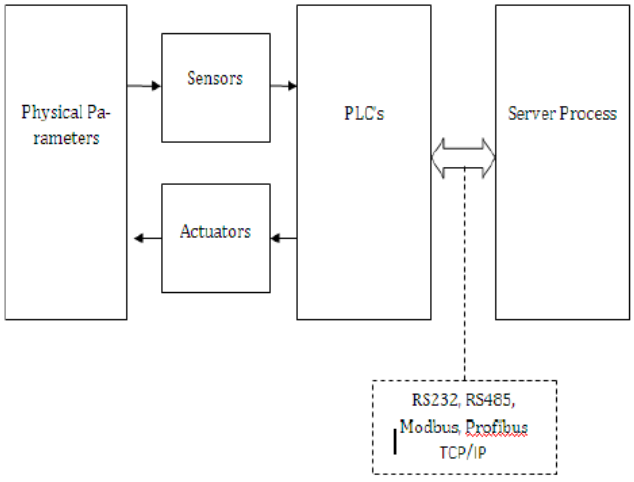

Fig. 1 Block Diagram

Visual Basic is used for the implementation of software and a control tool namely ActiveX is utilized for enabling a communication between Delta PLC and PC in a manner which is user friendly[2]. A remote client is used for the connection of a server to a network for administration and monitoring of a PLC[9].

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

III. DESIGNING A PLC

PLC controls fully or semi-automatic machines of cartooning that use mechanisms, optics, gas and electricity. Automatic cartooning of objects those look like bottle or plate such as products of food and health, medicine and automatic delivery of items, folding and delivering of instructions, loading of instructions and items into cartons, sealing of two ends of a carton and automatic removal of unqualified products. Also a linking with machines of blister packaging, that leads to the formation of packaging line. Machines of cartooning are broadly classified into "plate type cartooning machines" and "bottle type cartooning machines"[10], [11]. Second type of machines are used for packaging medicine bottles and former ones are used for medicine strips. For pharma industry, the process used for both the types of machines is nearly same. Machines of cartooning these days are capable of producing 80-100 bottles/min. Operation of cartooning machine is shown in following figure.

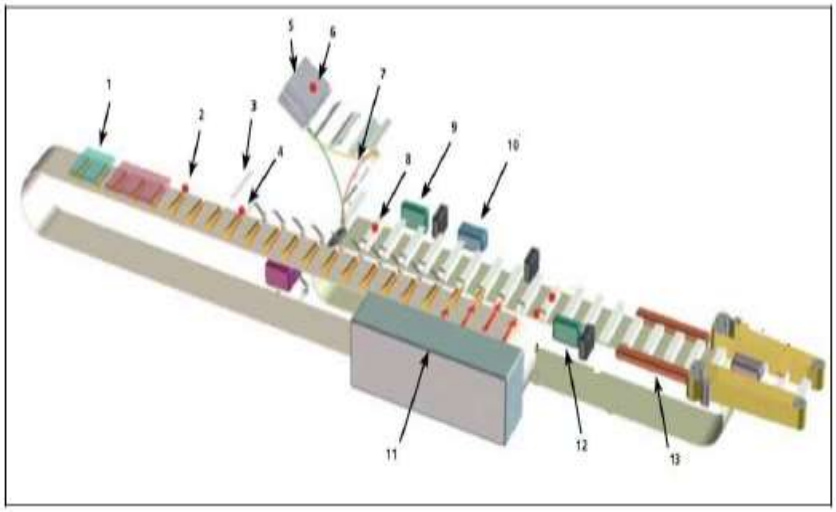

Fig. 2 Cycle of operation of horizontal cartooning machine

Steps of operation of cartooning machine:

III.I. Product Infeeding:

Product bottles are equipped into machine by placing the bottles upon conveyor belt, with star wheel's help. The absence or presence of bottle on star wheel conveyor is detected by a bottle sensor. A Cam is used for synchronization of this event. The proper placement of bottles on a conveyor belt is ensured by a product infeed.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Fig. 3 Product Infeeding

III.II. Leaflet Infeeding

A leaflet magazine is equipped on machine where a conveyor picks upon the leaflet. Products that does not contain leaflet may cause bypassing of leaflet magazine from its operation. A line which is parallel to bottled line of pocket conveyor moves a leaflet. The product is received by moving over chain rack of a carton. A proper pick up of carton is checked by fixing other photocells in magazine [12].

Fig. 4 Leaflet Infeed

III.III. Carton Feeding

A carton machine is equipped on machine for picking up the carton on conveyor. A ‘minimum carton load sensor’ is a photocell of minimum load which is equipped on a carton magazine. A line which is parallel to bottled

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

line of pocket conveyor moves a carton. The product is received by moving over chain rack of a carton. A proper pick up of carton is checked by fixing other photocells in magazine[13].

Fig. 5 Carton feeding

III.IV. Carton Forming

When carton is moved along a line which is parallel to the pocket chain then a carton is formed. The formation of carton is operated pneumatically. Two cartons are parted sideways by two suction paths that pick up mechanical components and folding of side flaps is done[14].

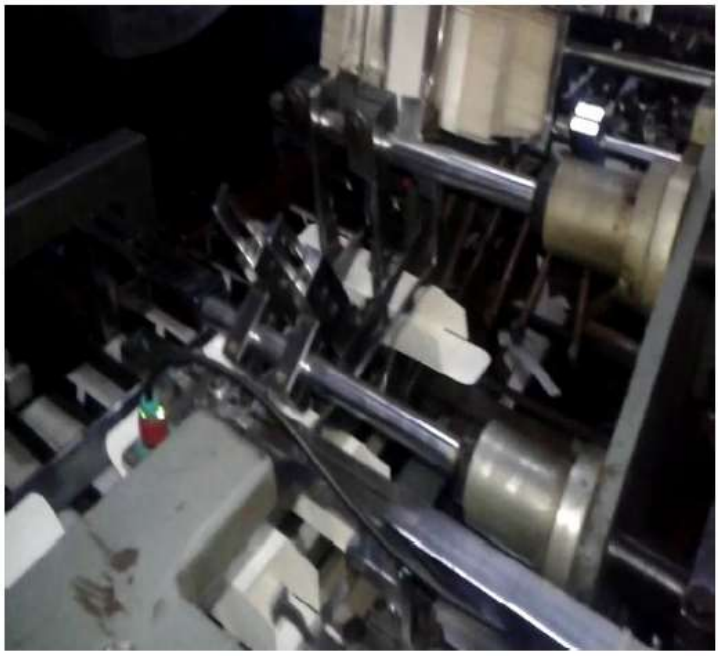

Fig. 6 Carton Forming

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Two photocells, namely ‘upper forming check’ and ‘lower forming check’ are equipped on conveyor of chain forming and transport. A ‘carton guide up sensor’ is used for guiding the carton above a conveyor at by mobile guide at the top[15].

III.V. Product Insertion

A pusher is used for inserting a product into a carton. A safety device is equipped on a pusher which is capable of moving the pusher guide backwards in the case of product harm. Any damages to a machine are avoided by using a safety system controlled by a ‘pusher safety sensor’.

Fig. 7 Product Insertion

III.VI. Closing of side flap and numbering

Proper closing of every side flap is ensured for each carton if it is properly formed or not and is placed on a conveyor guide which carries carton before that a central numbering device is followed by every carton. The central comb located in between two side combs is moved simultaneously for closing side flaps. When a carton code reader reads a code on carton moving along conveyor then a flap closure helps in closing flaps by numbering upper and lower flaps “A, A’ & B, B’”. The flap C’ and C. At the end, diversion of rejected cartons to different directions is done and those cartons that are properly formed come out of an outlet.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Fig. 8 Closing and numbering of side flap

IV. RESULTS

A number of individual processes are summed together as a cartoner for coordinating for the successful insertion of product into its container of packaging. It is largely used in industries of food and beverage. A variety of products that include insertion of food pouches of food product and shipping container of pharmaceutical bottles are included here. Cartoners used in earlier times was a mechanical contraption but today it is a synchronized and automated machine which is able to perform integrated operation of high speed. A "continuous horizontal cartooning machine" is developed by VB and DMT.dll.

IV.I. Application Results:

- Reduced number of mechanical components- a fall through design is achieved by elimination of mechanical components and mechanical stretch and slippage.
- Motion of all axis in a synchronized manner- motion of flap tuckers, feed belts, loaders and carton feeder are coordinated for throughput for high speed.
- Quick changeover of product- variable products are stored and created by selectable sizing by flexible controller of motion through HMI interface.
- Increase in throughput- faster motion by coordinating axis.
- Decrease in downtime- the application process is streamlined and mechanical breakage is eliminated and changeover time of product is reduced.

This GUI operates cartonining machine in a continuous manner in both manual and auto mode. The GUI display the speed of machine and a production counter. Four data registers of Modbus are simultaneously read in DMT Modbus.dll. The status of inputs such as bottle sensor, low carton level, leaflet sensor are shown by GUI. The status of outputs like cylinder 1, 2 and 3 and VFD is also shown by GUI. The screens of GUI are shown in following figures.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Fig. 9 Splash Screen

Fig. 10 Login screen of a user

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

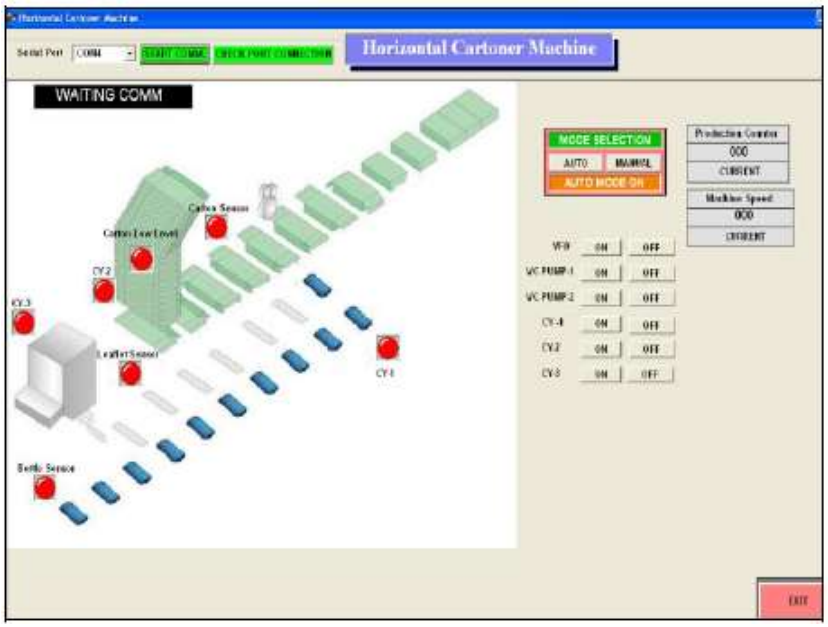

Fig. 11 Complete GUI of cartoner machine

V. CONCLUSION

The commensuration of designed SCADA is done with view of an industrial plan in real time, reduced time of time of troubleshooting for faults, operating personnel's safety. The plants can be visualized easily by adapting SCADA by manufacturing industries. Also, the rapid location of faults can be done and human tasks in dangerous environments can be replaced.

REFERENCES

[1] S. U. Abdi, K. Iqbal, and J. Ahmed, "Development of PC-based SCADA training system," in Proceedings of the IEEE International Conference on Industrial Technology, 2016.
[2] T. Kalaiselvi, R. Praveena, R. Aakanksha, and S. Dhanya, "PLC Based Automatic Bottle Filling and Capping System With User Defined Volume Selection," Int. J. Emerg. Technol. Adv. Eng., 2012.
[3] T. Y. Zhang, Y. Zhang, and X. R. Zhou, "Development on Serial Communication between Panasonic Electrical PLC and Computer Based on VB," Appl. Mech. Mater., 2012.
[4] S. Singh, "Intrusion Detection In SCADA Systems," Voyag. - J. Comput. Sci. Inf. Technol., vol. 4, no. 1, pp. 69–72, 2006.
[5] I. Turnipseed, "A new SCADA dataset for intrusion detection system research," PhD Propos., vol. 1, no. August, 2015.
[6] I. N. Fovino, M. Masera, M. Guglielmi, A. Carcano, and A. Trombetta, "Distributed intrusion detection system for SCADA protocols," in IFIP Advances in Information and Communication Technology, 2010, vol. 342 AICT, pp. 95–110.
[7] T. Erlandsson and M. M. Rahaman, "Testing and verifying PLC code with a virtual model of Tetra Pak Filling Machine," Inst. Inf. Technol., 2013.
[8] S. S. Ge, "Discrete-Event Systems," IEEE Control Systems. 2010.
[9] "Energy Monitoring System USING PLC &SCADAS," Int. J. Adv. Res. Electr. Electron. Instrum. Eng., 2014.
[10] S.-M. Won and J.-H. Kim, "A Study on the Remote Control of Factory Automation Equipment using the Modbus Protocol," Joural Korea Entertain. Ind. Assoc., vol. 5, no. 4, p. 194, 2016.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

[11] N. Yellamandamma, K. V. H. Rao, T. Sai Kumar, and A. Aggarwal, “Low cost solution for automation and control of MV substation using MODBUS-SCADA,” in 2009 International Conference on Power Systems, ICPS ’09, 2009.
[12] J. McConahay, “Using modbus for process control and automation,” Control Eng., 2011.
[13] S. Da’na, A. Sagahyroon, A. Elrayes, A. R. Al-Ali, and R. Al-Aydi, “Development of a monitoring and control platform for PLC-based applications,” Comput. Stand. Interfaces, 2008.
[14] K. Ruan, “Introducing cybernomics: A unifying economic framework for measuring cyber risk,” Comput. Secur., 2017.
[15] G. Mois, S. Folea, T. Sanislav, and L. Miclea, “Communication in Cyber-Physical Systems,” in 2015 19th International Conference on System Theory, Control and Computing, ICSTCC 2015 - Joint Conference SINTES 19, SACCS 15, SIMSIS 19, 2015, pp. 303–307.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019