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CIGARETTE PRODUCTION LINE FLOW AUTOMATIC CONTROL SYSTEM BASED ON PLC TECHNOLOGY AND EMBEDDED SOFTWARE

DING ZHI*, LIHUA XIE†, YONG XIA‡, AND JIE SHI§

Abstract. The automatic controlling system of the production will increase the preciseness of the work and it helps the employees to meet the organizational targets. The programming logic controller (PLC) and software-based technologies controlled everything interrelated with the production processes. This reduces the risk of production and evaluates the quality of the tobacco used to manufacture cigarettes. This study is based on secondary sources as which helps to get adequate information about the study topic. The implementation cost of the PLC is quite high, and proper training of the employees is needed for the manipulation of the PLC system of production. This is a computerised technology that supports the production process of the organisation and reduces the cost of production in the long term.

The term control technology is usually based on the control which is manual and on which the human operator has a general or primary role in following the procedures. These approaches are used for the decision-making and the execution of the programs and the operations, which are done manually.

Key words: PLC, Automatic controlling system. Software-based technology control technology

1. Introduction. In the era of technological development the machineries become an automated system and it helps the tobacco industries to produce more cigarettes. This helps in the cutting process of tobacco and increases the quality and quantity of the final output from the production system. The automatic machines slice the tobacco in the same pieces and insert the filters at the ends portion of the cigarette. The automatic control system helps in the maintenance of all the steps in a systematic way. This study has focused on the implication of the automatic control system in cigarette production and the effect of PLC technology in it.

The inventions in relation with the manufacture of the cigarettes in to system of control are able to control the manufacture of the cigarette-rod and the machines of the filter tipping. The rod making in the cigarette and the manufacture or the production of the filter trippers are very well-know. In recent years, the production or the manufacturing of the cigarette has been increased by the establishment of the double length rods of cigarette.

Automation and control technologies have revolutionized various industries by enhancing precision and productivity while reducing human involvement in manual processes. In the context of manufacturing, such technologies play a pivotal role in ensuring product quality, meeting production targets, and mitigating operational risks. This research delves into the application of automatic control systems, particularly focusing on the utilization of Programming Logic Controllers (PLCs) and software-based technologies to manage and optimize the intricate processes involved in cigarette production.

The tobacco industry, which encompasses the production of cigarettes, relies on advanced control systems to maintain the accuracy and efficiency of its manufacturing processes. Through the automation of key tasks, these systems help in achieving organizational goals, such as improving product quality and increasing overall output. Furthermore, they contribute to risk reduction, ensuring that the manufacturing process meets stringent quality standards. This study builds upon existing knowledge and insights, drawing from secondary sources to gain a comprehensive understanding of the significance of control technologies in the tobacco manufacturing sector. These secondary sources provide valuable information about the intricacies of PLC-based systems and software-driven automation, shedding light on their role in optimizing the production process.

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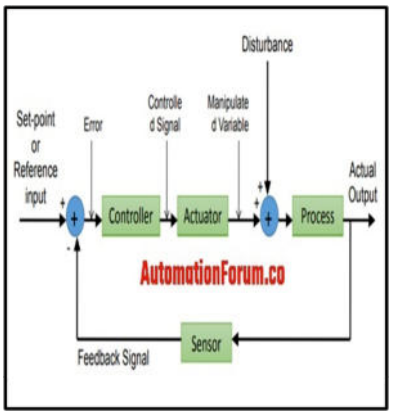

Fig. 3.1: Flow diagram of the Automatic Controlling System

2. Objectives.

1. To know the details of cigarette production line flow based on the automatic control system
2. To analyses the impact of PLC technology on the automatic production system of cigarette
3. To evaluate the challenges that occurred in the implication process of PLC technology and software in the production line flow of cigarette
4. To suggest the best possible way to enhance the production process through the utilization of PLC technology and an automatic production system.

This research provides a comprehensive examination of automation and control technologies in the context of tobacco manufacturing. It offers a detailed exploration of how these technologies are utilized to enhance precision, meet production targets, and ensure product quality in the industry. The paper delves into the role of Programming Logic Controllers, shedding light on their significance as central components of control systems in cigarette production. It provides insights into how PLCs are employed for managing and optimizing production processes.

3. Methodology. This study has been prepared based on secondary sources of information. Secondary sources include those sources which are already used by other organizations. The secondary sources are more easily available than the primary sources. The details of the PLC and the automatic controlling system of production have been understood from secondary sources. The PLC technology assists the employees to continue the production process and this decreases the risk in the business [2]. The development of precise quality of production could be possible through applying digital-based technology as this reduces the number of defaults in the production system [6].

3.1. Effect of automatic control system on the production of cigarette. The application of an automatic controlling system in the manufacturing process of tobacco-containing cigarettes is considered one of the major revolutionary procedures. Therefore with the help of this controlling system, the concerned procedures of production can be controlled [19].Under the cigarette manufacturing process, different types of functions have been used such as examination of the technical standard, investigation of the equipment and machinery that are used for production, method of processing the huge contents of tobacco, and the surrounding environment of the factory where the production process has been performed. The controlling system is capable of monitoring the layering capacity of the machinery that is used in the production process [2]. With this controlling ability, the capability of all the machines and the equipment used in the production process can be monitored and controlled by the excessive production of the cigarette as well.

The shown figure 3.1 contains the workflow of different equipment that is used in the automatic controlling system. First, the user needs to insert an input in the controlling system [10]. After that the input would automatically be sensed by the censoring machines. Once the input has been sensed then it is converted into the next phase where the presence of any kinds of errors has been detected in between the input object [5].

Then the object is further transferred between the controller and the actuator as well. After that by performing the final distribution the object has been undergone into the processed system and the outcome has been performed [11]. This whole process is performed automatically.

It has been observed that with the help of this automatic controlling system along with lowering the production rate the percentage of tobacco filling in each cigarette can also be controlled as well. This technical transformation is also associated with the development of fully automatic control over the excessive production of factories [26].When the tobacco filling becomes low then the adverse impact developed due to the tobacco filling of the particular amount gradually becomes low as well. This controlling nature-filling aspect is helpful in terms of lowering the problems of production [23]. The usual flow of machines that are used for manufacturing tobacco can also be measured and monitored by the automatic controlling system. When the autonomic system can be able to maintain the flow then it also creates an impact on the working consistency of the machines [8]. The flow-maintaining process helps detect any kind of warriors in the machine and not detect the errors but also mitigates the errors and maintains the flow and working consistency is also performed by the automatic controlling system. The production sytem increases the probability of the self-dependency nature of the organization [17]. Digitalized technology mainly controlled through an integrated and specialized system. This mode of production is more systematic in comparison to the other traditional processes [3]. Thus the development of this kind of technology helps to increase the production of cigarettes.

3.2. The meaning of PLC technology and its contribution to the automatic production system. Programmable logic controller is considered as an industrial computer which focuses on manufacturing processes. This technology has given importance to robotic devices, assembly lines and other activities which represents high reliability as well as process fault diagnosis [27]. In PLC technology data came from inputs and operational instructions can be sent through outputs. This technology came from automobile manufacturing industry which provides rugged programmable controllers for replacing hard real-time systems [27]. It also controls the other devices and makes decisions based on getting signals in input as well as it controls outputs. PLC consists of a microprocessor which has to be programmed with the help of a computer and this is written in computer software and then loaded into the PLC [21]. It is a digital computer that is used to control the work equipment in various factories.

PLC technology has been used in chemical industries, food industries, automated industries and biomedical industries. This technology has given a contribution on the automatic production of cigarettes and this machine consists of a control unit as well as successive workstations [24]. Each work stations have operating devices and control units connected to the workstations for controlling operating devices.

Cigarette production depends on the mixed proportion of five tobaccos and the blending process of tobaccos depends on the PLC technology. This technology helps to bring the accuracy of the blending process and it enhances the quality of the final output [15]. There are basically five scales present such as the leaf scale and the other four are called the auxiliary scale. The upper PC of center control sets the blending ratio based on each scale and then sends it to PLC before production [19]. The nuclear scale receives data from PLC and controls the motor speed. Blending accuracy came through this process and it increases the quality as well as automatic production of cigarettes.

Traditionally the manufacturing of the cigarettes have been effectively controlling and driven mechanically [22]. The variety of the rotating and the motions is necessary or important in the machines that are driven through the efficient gear boxes from the drive that are mainly used [16].

3.3. Challenges that occur during the implication of PLC technology in the automatic production line flow. The PLC technology is the form modular solid form of the computer followed the particular instruction. This system helps the organization to increase production [9]. This followed the customized instruction to continue the task. PLCs are industrial computers and are used to monitor different types of industrial activities [28]. The main problems that arrived from the PLC are related to the frequency interface, grounding and power. This means there is a need for a continuous power supply for the correct manipulation of the PLC technology [25]. The problems also arrived from the frequency interface as this frequency varies. The other challenges faced by the organization during the implementation of PLC in the production system are the high cost of maintenance, high cost of implementation [18]. The accounting of the PLC technology is complex, risk of data leakage and so on. The automatic controlling production may increase accidental issues. The

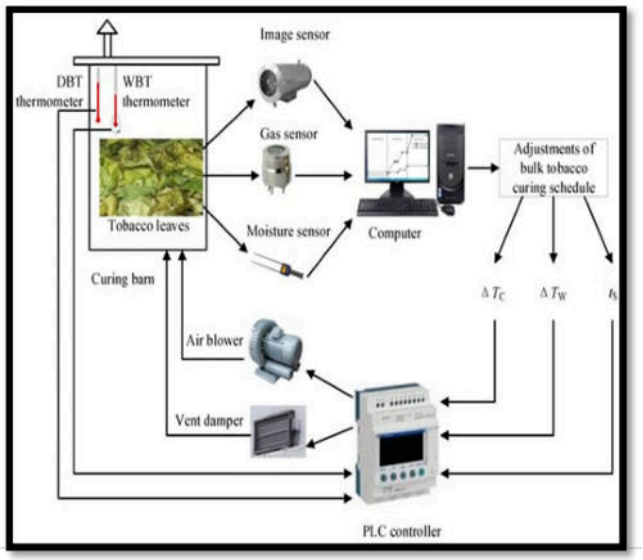

Fig. 4.1: Implication system of PLC for the development of bulk production unit of tobacco

maintenance cost and repetitive maintenance are another problems of automatic control production systems [1]. These are the drawbacks of the PLC and automated production system that may face by the organization during adaptation.

4. Result. The modern technology of cigarette production becomes more advanced and it increases the total quantity of the different cigarette-producing organizations. The automatic control system controls all the tasks related to production [22]. The automatic production system is digitalized technology in which all the production-related tasks continued through the computerized order. The implementation of the PLC technology increases the quality of the production and manages the wastage quantity of the raw materials [12]. This helps in the process of manufacturing superior quality products. The automatic controlling system helps in determining the quality of raw materials used in cigarettes. The tobacco cuts have been used as the raw materials of cigarettes. The development of the organizational production system could be increased through the implication and adaptation of the automatic machinery [7]. The PLC technology includes industrial computers to assist the program process. Digitalized technology increases the production quantity of all organizations. This brings revolution in the business and increases the production quantity [23].In modern times the production system is gone through the implication of the software. The software-based production system increases the preciseness in the production system. PLC technology helps in the checking process of tobacco quality and detects the faults easily [4]. This included a special alarm system to inform the default in the raw materials.

The figure 4.1 represents the steps followed in the cigarette production unit which is based on the PLC technology. All the things like moisture control, gas sensor, and temperature of the room are controlled by the PLC controller [14]. PLC controller is a computer based technology which helps the instructor to control all the tasks related to tobacco production. Along with the machinery layer, the rate of production in each of the layers is also under the monitoring radar of the controlling system of the automation process [11]. This process helps to lower the production rate in reach of the layers of the machines that are used in the cigarette machinery system.

The figure 4.2 represents the demand of the PLC will be high in the upcoming years. The market size of PLC was 11.21 billion US dollars and that increased to 12.51 billion US dollars in 2022. This demarcates that the demand for this technology is increasing. In the modern times, the industrial section becomes self-dependent with the development of technology. PLC helps the origination to earn more revenue from the businesses and it positively impact the organizational growth [20]. The PLC technology is an integrated system of processing

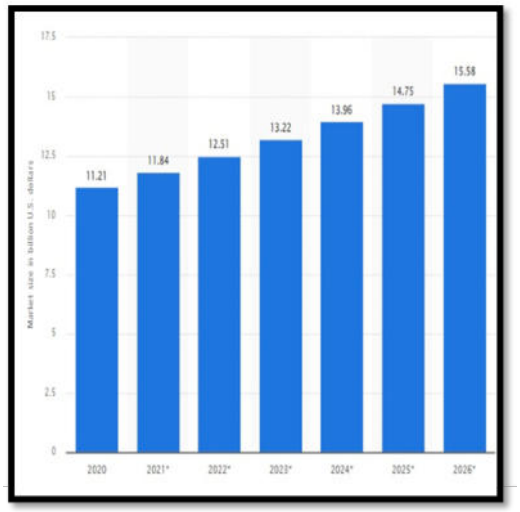

Fig. 4.2: PLC market size from 2020 to 2026

the production task of the industries. This helps in manipulating the temperature, dryness and the moisture [13]. The computerized technique shows all the incidents through the display. This monitoring system helps the organization to observe all the things that happening in the production unit [16]. Thus, the implication of this type of modernized technology is important for the organizational development.

5. Conclusion. In conclusion, this research has illuminated the profound impact of modern automation and technology on the production processes of the tobacco industry, particularly in cigarette manufacturing. The adoption of automatic control systems, driven by Programmable Logic Controller (PLC) technology, has revolutionized the production landscape. This transformative shift has not only increased the overall production quantities but has also ushered in a new era of precision and quality control, surpassing traditional production methods. The influence of software-based technology in conjunction with PLC systems has been instrumental in enhancing the efficiency and effectiveness of the production process. It significantly minimizes errors and discrepancies in the production line while making use of advanced tools such as radar sensors and cameras for real-time quality assessment. The integrated control system ensures that every aspect of production is closely monitored and managed, allowing organizations to achieve higher production volumes and superior product quality. The implementation of these modern technologies represents a pivotal step forward for the tobacco industry, streamlining production processes, reducing raw material wastage, and improving the quality of the end products. As we look to the future, the continued growth and demand for PLC technology further underscore its importance in enhancing production, paving the way for further innovation and growth in this vital industry.

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