Scholar Publishing Group
International Journal of Engineering Technology and Construction
https://doi.org/10.38007/IJETC.2021.020102
ISSN 2789-7176 Vol. 2, Issue 1: 16-28

PLC is Used to Realize the Electrical Control of the Lotus Seed Core Breaker

Ming Li

North China Electric Power University, Baoding, China

liming@ncepu.edu.cn

Keywords: Lotus Seed Wear Core, Sheller Research, PLC System, Electrical Control System

Abstract: Due to the low control system of the traditional lotus seed core-shelling and shelling machine, its production efficiency, safety and work reliability are relatively low. The programmable controller PLC in the field of control system technology can better achieve the management and control goals of the control system, such as safety and efficiency. Therefore, it is necessary to carry out electrical control research based on the realization of the lotus seed core-shelling machine using PLC. The purpose of this article is to solve and improve the related problems of the electrical control system of traditional lotus seed core-shelling and hulling machine. Through PLC technology, a detailed analysis and detailed analysis of how the electrical control system of lotus seed core-shelling and hulling machine can be processed more efficiently. The research and analysis of the main problems in the electrical control system of the lotus seed core-shelling and hulling machine, and the innovative application of PLC technology to the lotus seed core-shelling and hulling machine. Feasibility of electrical control of shelling machine. The research results show that this kind of lotus seed core-piercing and shelling machine using PLC electrical control system can make the lotus seed core-piercing and shelling work easier, more convenient and efficient, and can effectively improve the shelling rate of 2.5-3.4kg / h; wear The core rate is 1.0-1.7kg / h, the clean-up rate of the lotus core reaches 1%, and the crushing rate is reduced by 1%.

1. Introduction

With the rapid development of economy in recent years, people's living standards are constantly improving, and their requirements for the basic needs of life are also constantly increasing [1].As a kind of nut, lotus seeds are popular in the market, where the demand for lotus seeds is increasing day by day. However, traditional processing of lotus seeds cannot meet the huge demand in the

Copyright: © 2021 by the authors. This is an Open Access article distributed under the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (https://creativecommons.org/licenses/by/4.0/).

market, especially in the process of seed hulling, which takes the longest time and has the lowest work efficiency [2].Now the appearance of the lotus seed through the core sheller is a good solution to this problem, but its efficiency is not ideal. Traditional shell lotus processing usually refers to several processing steps, such as peeling, peeling and core-removing, to obtain lotus seed products, which belong to the early processing process of lotus seeds [3].Therefore, the technology and equipment of nut shell stripping is the bottleneck of nut food development and deep soil adding. This kind of working principle can achieve a better effect of peeling, but the processing of lotus seeds is more difficult than that of common nuts, and the hardness of the shell is the largest, in addition to the shell, but also to remove the inner layer of the skin and the core of the lotus [4].Therefore, with a single machine far to achieve the effect, but also need to be supplemented by a large number of artificial, therefore, the development of modern processing is mechanical light, electrical integration of processing and sorting equipment. Now, our country's shell lotus processing, usually rely on manual use of simple tools, but also some are the use of low technology level of small machinery to complete the shell lotus classification, shell, core and peeling process. The working process of simple machine is basically as follows: firstly, the lotus seed shell is cut one by one with a blade embedded in the wood board, then the shell is extruded and shelled, then the steel needle is used to Pierce the core, and finally, a small amount of grinding wheel is used to grind the skin [5].This kind of processing technology is low in efficiency, high in labor intensity, high in lotus seed loss rate, and high in labor cost. As a result, the product quality is extremely unstable and cannot adapt to large-scale production, which seriously affects the production capacity and benefits, as well as the comprehensive utilization rate of lotus seed.

In addition, the traditional lotus seed core-shelling and shelling machine basically uses manual control or single-chip microcomputer control. This control method is inefficient, has low reliability, and production safety is difficult to guarantee. The application of PLC automation in electrical control It is becoming more and more common, effectively simplifying the relay logic, thereby improving the safety performance of electrical equipment automation control systems, and at the same time greatly reducing the actual production cost of electrical equipment [6]. PLC technology is a convenient operation technology that integrates the programming and manipulation of computer digital technology. It has many convenient and fast functions [7]. PLC technology implements a specific and reasonable plan for the comprehensive and serious internal specific situation of each electrical equipment. At the same time, PLC technology can simplify the programming process and the operation process through its own algorithms and programming, So that the electrical automation control program can quickly expand the programming program, and can also effectively improve the program's operating rate and intelligent level, reduce losses and save production costs. PLC technology is applied in a simple and intuitive instruction mode in the application operation, which will be relatively simple to operate [8]. The emergence and effective application of PLC technology has made the operation simpler. On the one hand, it has greatly reduced the difficulty of learning. It can make people learn more easily, use related skills in a shorter time, and prevent operation errors from damaging the equipment. Accidents during normal operation, and ensuring the normal operation of electrical equipment, improve work efficiency, and enable enterprises to develop better [9]. PLC technology in the electrical engineering automation control system can have better safety performance. PLC technology has a good anti-interference ability to the power system, ensuring that it can still exert its best results in complex working environments. In the development of PLC technology in recent years, the technology has been well improved and innovative, has achieved good results in terms of safety performance, and maintained the stable operation of electrical equipment [10]. The PLC technology with perfect functions can be well adapted in the automation control system of electrical equipment. At the same time, it also has a lot of configuration facilities and is also very functional.

In order to better improve the working efficiency of the lotus seed core-shelling and hulling machine, an electrical control system for a lotus seed core-shelling and hulling machine based on PLC is established in this paper. Among them, Jinghua Guo made a detailed introduction to the current mechanical electrical control system, and pointed out the importance and feasibility of the electrical control system [11]. In his article, X. Zhao put forward the application of the electrical control system in various industries, and explained the electrical control system construction of the lotus seed core-shelling and shelling machine based on PLC and the main technical problems, and solved it. Scheme [12]. Osamu Yatsubo elaborated the basic definition of electrical control system and its purpose in detail in the article, and set up a simple electrical control system independently, and applied it to actual engineering, and obtained a lot of experimental data [13]. P.-H put forward some common problems of the PLC control system, and proposed ideas for the problems that may be encountered in the electrical control system of the lotus seed core-shelling and shelling machine based on PLC [14]. Wang, C proposed the details of the work of the PLC control system for machinery, and explained the stability and reliability of the PLC control system [15]. SHI Lang-feng proposed the application of PLC technology in electrical control and the solution of common problems [16]. Haijun Yu proposed the specific construction process of the electrical control system of the lotus seed core-shelling and shelling machine using PLC technology, which is very useful for the establishment of the target system [17]. Du, Y analyzed the impact of PLC technology on the operation of hoisting mechanical control systems, especially in the area of electrical control [18]. ZHANG Liang proposed the standards and types of related control indicators in PLC technology, which can greatly improve the stability of mechanical work [19]. Zhu, H proposed the establishment of a PLC-based electrical control system for a lotus seed core-shelling and shelling machine, and made some ideas about the key technologies and the problems to be solved [20].

To put it simply, this article focuses on the effective application of PLC technology to the electrical control of lotus seed corers and hullers, that is, by understanding the current electrical control modes and existing problems of lotus seed corers and hullers, and to understand PLC technology, Furthermore, the PLC technology is combined with the lotus seed core-shelling and hulling machine to create an electrical control system based on the PLC. Specifically, the main research content of this article is roughly divided into five parts: the first part is the introduction part, which aims to systematically review the main research content of this article from the research background, research purpose, research ideas and methods; the second part is The theoretical basis, a detailed and systematic summary of the current theories and methods of the electrical control of the lotus seed core-shelling and shelling machine, and the current application and influence of PLC technology in the electrical control system; the third part is a summary of the current lotus seed The research status and existing problems of the electrical control of the core-through sheller, analyze the causes of the problems, summarize the ways to optimize the electrical control system, and construct the optimization objective function; The fourth part is the detailed design, based on the relevant theories and electrical The optimization method of the control system is to establish the electrical control system of the lotus seed core-breaking and shelling machine based on PLC. The fifth part is the summary and suggestion of this article of the electrical control system of the machine.

2. Proposed Method

2.1. Working Principle and Electrical Control Principle of Lotus Seed Coring and Shelling Machine

As for the working principle of the lotus seed core-shelling and shelling machine, it is roughly

that the lotus seeds to be processed are fed from the hopper through a horizontal conveying stirrer so that the lotus seeds are placed in a long axis direction from the natural state, and enter the indexing disc from the feeding position mouth To achieve intermittent feeding. After the lotus seeds enter the indexing disk, the lotus seeds are clamped and accurately positioned by an automatic clamping mechanism. When the lotus seeds are in the core-penetrating position, the core-piercing mechanism is used to achieve the core-piercing of the lotus seeds. The lotus seeds are in the shell-cutting position. Under the combined action of the shell-cutting mechanism and the indexing disc, the lotus seeds are cut and unloaded. Regarding its electrical control principle, the movement control of the entire mechanism is realized by using electromagnetic hydraulic control directional valve and stroke control valve. When the driving oil cylinder sends the lotus seeds to the core-penetrating position, the positioning and clamping oil cylinder moves quickly to quickly clamp and position the lotus seeds. At this time, the core-piercing control cylinder and the feed-return control cylinder synchronize the movements and the core-piercing and the lotus seeds are ejected into the shell-cutting mechanism at the same time, and then the shell-cutting control cylinder drives the shell-cutting cutter to move. When the shell is cut, the driving cylinder starts to rotate the indexing disc and enters the next cycle.

At present, the first shelling machine developed in the market is the 6CB lotus seed core-shelling and shelling machine. Its appearance has changed the previous semi-mechanical and semi-manual operation of lotus seed processing. The basic work is based on lotus seeds. The size of the individual basically uses the combination of electric, hydraulic, and mechanical control methods, using dynamic clamping targets, and then centering to achieve elector-hydraulic control of the cutting force of the shell and the relationship between the movements of various components, which can not only achieve The goal of wearing the core first and then shelling can effectively improve the production efficiency of lotus seed processing, basically eliminate the hidden dangers of production, and can greatly improve the quality of the finished product of lotus seed processing. This type of 6CB lotus seed core-shelling and shelling machine is usually implemented with contact control as the primary control system, which makes the control system less reliable, but its service life is often not long, so its obstacles The rate is high. In order to better solve these disadvantages, the control system of the new lotus seed core-shelling and shelling machine has begun to use a single-chip microcomputer as the control core to achieve the system control of the machine, which not only improves the reliability of the system work, but also increases the production efficiency, for improvement.

In addition, when entering the automatic working mode, the situation is simulated, Y and Y2 are powered at the same time, so that the core-piercing motor and the electromagnetic oscillator run at the same time; when XIO has an input signal, Y10 is powered and self-locking, and the pressure control directional valve Yd is powered, Drive the oil cylinder to enter; meanwhile, Y12 is energized and self-locking. The core-piercing control valve YD3 is energized to drive the cylinder to enter and realize core-piercing. When X13 has an input signal, Y12 loses power and Y13 is self-locking and core-piercing. The control directional valve YD3 loses power, and YD4 receives power to drive the cylinder back.

2.2. PLC Development and Application of Technology

In the field of PLC technology, due to the rapid development of China's industrial field, the demand for advanced technology is high. Therefore, many policies in China are very conducive to the research and development of PLC technology. In general, China's current application of PLC technology has a good development trend. At present, China's PLC technology has not only received the support of many enterprises in electrical equipment automation control systems, but

also related technical personnel have a deeper understanding of computer technology, and have obtained fruitful scientific research results. These scientific research results are in PLC technology. It also has perfect and promoted use, and has made good progress in many aspects such as the program operation speed and scientific intelligence of electrical equipment. Therefore, we can believe that the future PLC technology will be completer and more excellent, and people will have more intelligent and convenient electrical appliances in their lives. It is easy to consume a lot of energy during the operation of the electrical engineering automation control system. Once the energy consumption is too large, it will affect the stable operation of the electrical equipment, causing the factory to fail to perform normal production operations. The correct and reasonable use of PLC technology can effectively reduce energy consumption, thereby reducing the chance of electrical equipment not operating normally, and optimizing relays to effectively improve control efficiency and allow stable and normal operation of plant equipment.

In addition, it can be seen from the practice of PLC technology in the electrical engineering automation control system that the operation of PLC technology on electrical equipment is implemented by replacing the relay with a programmed memory, which has achieved the effect of improving the level of control. The influence of external conditions can easily reduce the stability and reliability of the digital control, and the situation of electrical equipment working efficiency is not high. It can be found from the related scientific research results that the PLC technology combining communication technology and relay can allow automatic control of electrical equipment. Therefore, related technical personnel should combine PLC technology and control system to make reasonable application of switch control, improve the actual operating efficiency of electrical equipment, and better meet people's needs.

The working process of PLC automatic operation control mainly includes two working processes, namely automatic core-piercing and automatic shelling. XlO-X21 are the input points of the limit switch input signal when clamping, loosening and advancing and reversing the valve when threading. And the signal input point of the stroke limit switch during the clamping and loosening of the index plate. YIO-Y21 is the output signal points required to control the YDl-YDl0 DC reversing valve. M500-M510 is an auxiliary relay with self-locking function in PLC. The purpose of using these points is to prevent a power failure in the middle of automatic processing and to maintain a working mode selected in order to ensure its automatic processing continuity of the process. Then realize the entire automatic control.

3. Experiments

3.1. Related Processing of Experimental Data

During the experiment, there is a large amount of experimental data to be processed, and there must be errors in these data. It is also very important to handle the errors appropriately. Therefore, before using these experimental data for forward and reverse analysis, the error should be processed and analyzed on the original data. Generally, the errors of the experimental data can be divided into three types: system error, random error and gross error. Among them, random errors are often caused by random factors, and their signs and absolute values are irregular. However, as the number of experiments increases, random errors are generally considered to be normally distributed. The gross error mainly refers to the fact that in the statistical data, due to the observer's carelessness, or sudden changes in environmental conditions, unstable instrumentation and other factors, the observation error does not conform to a certain statistical distribution rule, which is usually a measurement error. System error is the error caused by the measurement instrument, the change of the measurement reference and the influence of external conditions. At present, the systematic error of observations is generally composed of corresponding statistics based on the statistical

characteristics of observations, and then test hypotheses are made based on the characteristics of their probability distributions, and judgments are made by comparing actual calculated values with quantifier values. Common test methods are: U test, variance test, t test and so on. In the measurement process, the gross error should be eliminated, and the system error should be eliminated or weakened, so that the observation value contains only the random error I, 0.

At present, when resolving this kind of problem at home and abroad, the least square method is usually used to process the experimental data twice. The basic idea of the least square method is to first assume that the observations only contain accidental errors, but this is basically not true in reality. Possibly, for this reason, a new theory has been developed to study systematic errors and gross errors. At present, the more effective method for processing systematic errors is the additional parameter method; there are two methods for processing gross errors. One is the data detection method that still belongs to the category of least squares, and the other is the method of robust estimation different from the least square's method. Or robust estimation. In addition, in the mechanical control operation, all production-related links are constantly changing, and the control system is also in motion, which means that the entire control process is dynamically changing, so there will be relative errors in experimental management. Inevitably. Modern error theory generally believes that the measured true value cannot be determined, and the existence of the quantum effect excludes the existence of the unique true value, so the error cannot be accurately obtained. The error used in the experiment in the past is actually a kind of deviation; the experimental error evaluated is actually unavoidable and uncertain.

3.2. Experimental Conditions

Because China's market economy started late and its development time was short. Therefore, PLC technology lags far behind the developed countries in the world in the early years. However, in recent years, China has made rapid development in the fields of Internet and other scientific and technological information technologies, and has also carried out a lot of research and development in PLC and various automatic control Intensity, at present, the domestic application of PLC technology is relatively mature, and there are many fields of application. Although the types of programmable controllers vary widely, they have many common characteristics in order to be used in harsh industrial environments. Strong anti-interference ability-In terms of hardware, the first is to select high-quality components, adopt a reasonable system structure, and strengthen and simplify installation to make it resistant to vibration and shock. In terms of software, the PLC also took many special measures, set a watchdog clock, and refreshed the WDT regularly when the system was running. Once the program appeared an infinite loop, it could immediately jump out, restart and issue an alarm signal. Simple programming—it uses easy-to-understand ladder language and simple instructions for industrial control. Easy to use and maintain. Short design, construction, and commissioning cycles-When a programmable controller is used to complete a control function, design and construction can be performed simultaneously because of its hardware and software. Easy to achieve mechanics-because the programmable controller has a compact structure, small size, light weight, high reliability, strong resistance to vibration and moisture, and strong heat resistance, it is easy to install inside the machine and equipment to manufacture mechanics products.

In addition, there are many typical applications of PLC technology in China's industrial field. Today, PLC has been widely used in various fields at home and abroad, such as industry, manufacturing operations, light industry, coal industry, transportation and entertainment industry. PLC uses digital operating system to complete various control functions of automation equipment. Under the action of input signals on site, it controls the on-site execution mechanism according to the per-programmed program and works according to the designed actions. Its main function is:

PLC replaces the traditional relay control system, and realizes logic control and sequence control. It can not only control a single device, but also multi-user group control and automatic assembly line. This is the most basic and most widely used field of PLC. At present, almost all products of major PLC manufacturers in the world have motion control functions. The motion control function is the control of PL for circular or linear motion. Such as the use of PLC to control elevators, robots, machine tools, segmented blanking of complex parts, grinding and other applications.

3.3. Experiment Object and Equipment

The object of this experiment is to use a new type of lotus seed core-shelling and hulling machine using a PLC electrical control system in a domestic processing plant, and to test the PLC control system for improving the efficiency and safety of lotus seed core-shelling and hulling feasibility. The electrical control system of the lotus seed coring and shelling machine based on PLC established in this paper mainly uses PLC technology, as well as Internet of Things sensing and identification technology, Internet of Things communication and application layer technology. These technologies and the equipment needed are the main experimental conditions and equipment for this experiment. The so-called Internet of Things perception and identification technology refers to the Internet of Thing's collection of information through perception and identification, and is the main data source of the Internet of Things. Sensing technology mainly embeds sensors around or on an object, collects data of the object or the surrounding environment, and senses various physical or chemical changes. Commonly used technologies include sensor technology, radio frequency identification technology, and so on. The sensor is the main source of information for the application of the Internet of Things.It senses the status information of the measured object, converts the perceived information into electrical signals or other forms of information, and then outputs it, which satisfies information transmission, storage, processing, and recording. , Display and control requirements, and finally achieve automatic detection and automatic control functions.

As for the type of PLC used in this article, after detailed investigation and selection, Mitsubishi PLC was selected. Mitsubishi PLC uses a type of programmable memory for its internal storage program, which performs logic operations, sequence control, timing, counting and arithmetic. User-oriented instructions such as operations, and control of various types of machinery or production processes through digital or analog input / output. The Mitsubishi FX series is composed of CPU, memory, input and output devices, and power supply. FX2N series is the most advanced series of Mitsubishi PLC in the FX family. Because the FX2n series has the following features: the largest range of standard features, faster program execution, comprehensive supplementary communication functions, suitable for different power supplies in various countries around the world, and a large number of special function modules that meet a single need, it can be used for your factory automation Provides maximum flexibility and control. FX2n series is a special function developed by FX series PLC for a large number of practical applications. It has developed a range of special function modules to meet different needs analog I / O, high-speed counter built-in 24V DC power supply, 24V, 400mADC power supply Can be used for peripheral devices such as sensors or other components. The specific performance indicators of FX2N series PLC are shown in Table 1:

Table 1. Multiple performance index of FX2N PLC

FX2N	Position Control Shaft	Special Function Module	The Power Supply Mode
FR-FX1S	16 axis	8	Built-in
FR-FX2N	14 axis	8	Built-in
FX2N-48	16 axis	8	Built-in

As can be seen from Table 1, the performance indicators of the FX2N series PLC are very good. Among them, the positioning control reaches 16 axes, the built-in power supply is simpler, and it is equipped with 8 special function modules.

4. Discussion

4.1. Influence of Traditional System Control Methods on the Work of Lotus Seed Corers and Sellers

In order to better highlight the superiority of the PLC method in the electrical control of the lotus seed core-shelling and hulling machine, the traditional control method was adopted for the lotus seed core-shelling and hulling machine of the experimental object, and the production volume and production efficiency were used as a reference. Manual control or single-chip microcomputer control, as a traditional mechanical control method, plays an important role in the mass mechanization of the industry and is the key technology for many ordinary mechanical operations. However, many traditional electrical control systems have many technical challenges in dealing with many operating states. The machine can work effectively under the simple working conditions and short working time, but when the working time is intensified and the working conditions are complicated, the traditional control technology is difficult to meet the working requirements, which will greatly reduce the safety and reliability of the mechanical operation and it is easy have an accident. The working efficiency and normal working time of the lotus seed core-shelling and shelling machine under the traditional control system are shown in Table 2:

Table 2. Traditional control system under the lotus seed core sheller working conditions

Categories of Control	Normal Working Hour	Work Efficiency	Off-take Potential
Manual Control	6.2h	23.5	2.35
89c51	10.2h	35.5	4.65
89c52	9.85h	34.26	3.78
Stm32	9.8h	33.54	3.21

The data in Table 2 reflect the working efficiency and normal working hours of the lotus seed core-shelling and hulling machine under the traditional control mode. The work survey was conducted on the lotus seed core-shelling and hulling machine under the four control modes. Hours, the production efficiency is generally around 20-30%. These data are obtained under ideal working conditions. If the working conditions are worse, the machinery is prone to failure and the working time will be greatly reduced, which is difficult to meet the huge market. Demand can only be met by a large number of manual husks.

This control system is realized based on a 89C51 single-chip microcomputer, and the hardware composition of the control system is relatively simple. In this control system, the corresponding control action is mainly realized by detecting the pressure amount of the hydraulic system and the displacement amount of the stroke control valve to complete the corresponding processing procedures. The pressure measurement uses a 0-0.5MPa pressure sensor, and the displacement detection uses an electronic proximity switch. The control system is mainly composed of 89C51, interface chip 8279, opt-isolation TCP250, driver 74LS06, and A / D conversion chip ADC0816. Among them, the total value of 1/0, including the switch value and the analog value, is an important indicator. For the reliability and control amount of the control, the total amount of 89c51 single chip

microcomputer indicators used in the experiment, as shown in Figure 1:

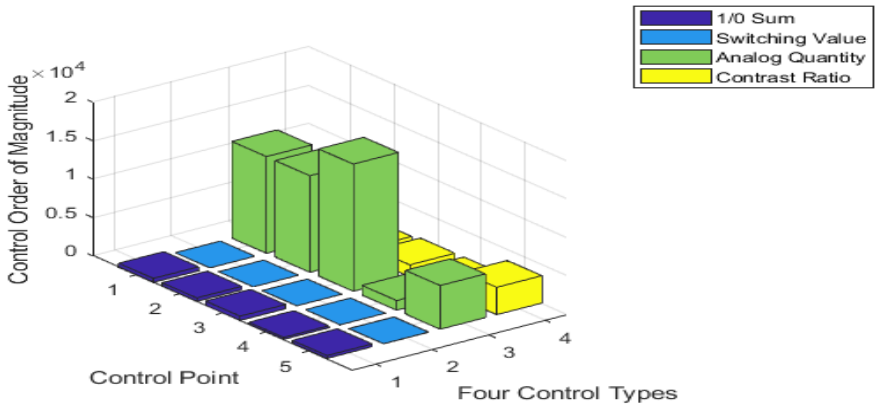

Figure 1. Single chip microcomputer control index order of magnitude

From the data in Figure 1, it can be seen that when the single-chip microcomputer is used to achieve the electrical control of the lotus seed core-shelling and hulling machine, the working efficiency ratio of the lotus seed core-shelling and hulling machine is significantly stronger than the original manual control in the actual production link. In addition, due to the improbability of the single-chip microcomputer, the electrical control system of the lotus seed coring and shelling machine based on the single-chip microcomputer is more adaptable to working conditions, and its control indicators are still acceptable.

The software part of the control system based on the 89C51 single-chip microcomputer mainly includes the pressure quantity detection program, core subroutine, shelling subroutine, time delay program and keyboard / display program. The flowchart of the main program is slightly more complicated. The basic control flow is to set the initial value first, and press the start key to initialize the system. Start the hydraulic drive motor M1, the hydraulic system works, and check whether the hydraulic pressure reaches the set value. If it does not reach the set value, wait for the system to pressurize; if it reaches the set value. Then the system maintains pressure, and then calls the lotus seed threading subroutine. After the core-piercing is completed, the lotus seed shelling subroutine is called again. After hulling is complete, determine if there is a stop command, if not, proceed to the next cycle; if there is a stop command, end the processing of lotus seeds. The results of the electric control system of the lotus seed core-breaking and shelling machine based on the single-chip microcomputer for its shelling, core-piercing, and lotus core core-breaking rate and crushing rate, as shown in Figure 2:

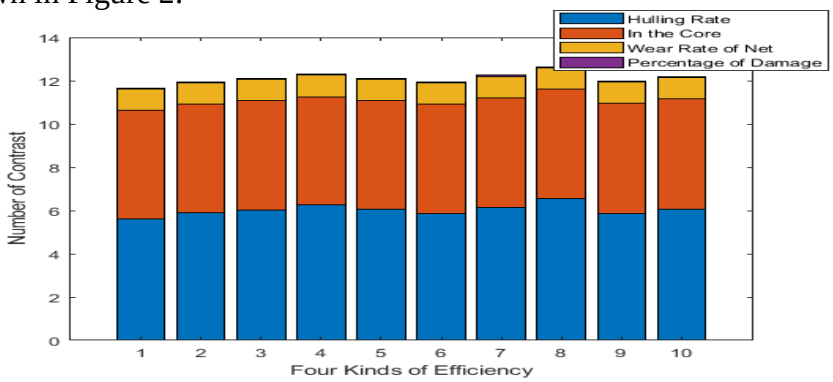

Figure 2. Single chip microcomputer control sheller productivity

It can be seen from Figure 2: When using a single-chip microcomputer to realize the electrical control of the lotus seed core-shelling and hulling machine, the productivity of the lotus seed core-shelling and hulling machine is significantly improved compared to manual control. ; Wear core can reach 5.0-5.1kg / h, lotus core wear rate can reach 98%, and the breakage rate is less than 5%. This control method eliminates some hidden dangers to production safety and improves the finished product to a certain extent. The quality of lotus increases the added value of the product.

4.2. Analysis of the Influence of PLC Control Methods on the Work of Lotus Seed Corers

A programmable controller is an electronic system of digital arithmetic operations, designed for applications in industrial environments. It uses programmable memory to store instructions that perform logical operations and sequence control, timing, counting, and arithmetic operations within it, and control various types of machines through digital or analog input and output interfaces Equipment or production process. The design principle of the programmable controller and its related equipment is that it should be easily integrated with the industrial control system as a whole and have extended functions. The working efficiency and normal working time of the lotus seed core-shelling and shelling machine under the PLC control system, as shown in Table 2:

Table 3. Plc control system under the lotus seed core sheller working conditions

Categories of Control	Normal Working Hour	Work Efficiency	Off-take Potential
FX2N-48	11.2h	43.5	6.32
FR-FX1S	11.4h	45.5	7.64
FR-FX2N	11.7h	54.26	6.85
FR-FX2NC	12.5h	53.54	6.41

The data in Table 3 reflects the working efficiency and normal working hours of the lotus seed core-shelling and hulling machine under the PLC control mode. The work survey was conducted on the lotus seed core-shelling and hulling machine under the four types of PLC. The average daily normal working time reached 11.7. Hours, the production efficiency is generally around 40-60%. These data are obtained under poor working conditions. If the working conditions are better, the machinery will rarely fail, and the working time will be greatly improved, which can basically meet the huge market. Demand, reducing the need for manual husking.

This article uses the FX2N series PLC. The following points must be considered before the experiment. First, the total number of input and output points is controlled within 256 points. However, the total number of input and output points of the Mitsubishi FX2N programmable controller is within 256 points, and the input and output points are within 184 points. When connected to the function expansion board, it does not occupy the number of input and output points. When special units and special modules are connected, each takes 8 points and is deducted from the maximum 256 points. Calculate the input and output points of this system according to the hardware selection scheme of the main control system. According to statistics, enough input and output points of the main control system of the mine hoist. Among them, the total of 1/0, including switching and analog, is an important indicator. For the reliability and control of the control, the total amount of FX2N series PLC indicators used in the experiment, as shown in Figure 3:

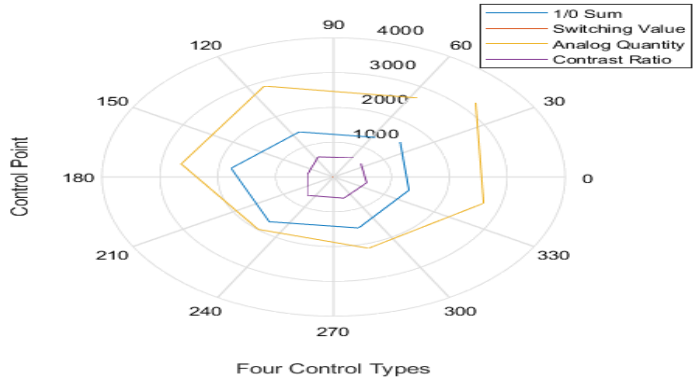

Figure 3. The PLC Control system control index order of magnitude

From the data in Figure 3, it can be seen that when the PLC is used to realize the electrical control of the lotus seed core-shelling and hulling machine, the working efficiency ratio of the lotus seed core-shelling and hulling machine is significantly stronger than the original traditional control in the actual production link. In addition, because the PLC can be programmed remotely at any time, the electrical control system of the lotus seed coring and shelling machine based on PLC is more adaptable to working conditions, and its control indicators are very good.

Since there is a certain hidden trouble during the operation of the PLC control system, when an unexpected situation causes the electrical equipment to stop running, it can be supplemented with a conventional control system to allow the electrical equipment to return to normal as quickly as possible, ensuring that the plant can perform normally. Production operations to reduce the loss caused by the plant's failure to operate normally. In general, the PLC control system can be divided into three units: electronic regulation, elector-hydraulic execution, and transfer to measurement. Through the regulation of these three units, the regulation of electrical equipment transfer can be reasonably controlled, and the rationality of regulation can be stabilized. The results of the electric control system of the lotus seed core-breaking and shelling machine based on the single-chip microcomputer for the shelling, core-piercing, and lotus core core-breaking rate and breaking rate, as shown in Figure 4:

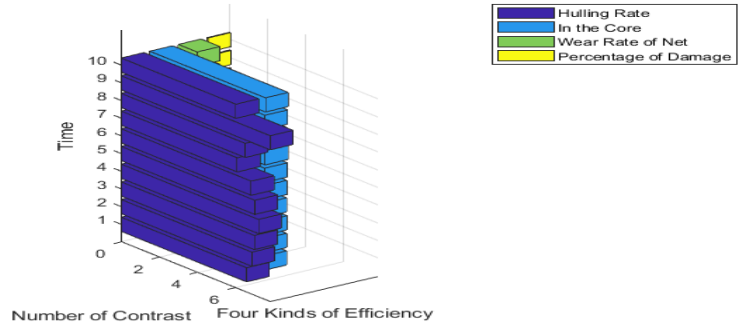

Figure 4. The superiority of similar data statistical processing in data mining

It can be seen from Figure 4 that when the single chip microcomputer is used to achieve the electrical control of the lotus seed core-shelling and hulling machine, the productivity of the lotus seed core-shelling and hulling machine is significantly improved compared with the traditional control, of which the shelling can reach 6.5-7.4kg / h ; Wear the core up to 6.0-6.7kg / h, the cleansing rate of the lotus core can reach 99%, and the breakage rate is less than 3%. This control method eliminates the hidden dangers of production safety and improves the finished product to a

large extent. The quality of lotus increases the added value of the product.

5. Conclusion

(1) This article analyzes the common problems existing in the traditional lotus seed core-shelling and shelling machine. It does not solve these problems, discusses them, and proposes corresponding solutions.

(2) Introduced the PLC technology, and combined the PLC technology with the lotus seed core-shelling and hulling machine to establish a PLC-based lotus seed core-shelling and hulling machine with high efficiency and reliability.

(3) The influence of the PLC control technology on the work of the lotus seed core-shelling and hulling machine was researched, and the corresponding technical and theoretical guidance was proposed to solve the problem of low efficiency and poor safety and reliability of the lotus seed core-shelling and hulling machine Related issues.

(4) Discussed the difference between the traditional control technology and the electrical control system of the lotus seed coring machine based on PLC, highlighting the advantages of PLC technology in mechanical electrical control.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Do-Hyeong Kim, & Jae-Hoon Choi. (2019) "Analysis of the Transmission Performance of Control Pilot Signal Lines for Charging Communication in Electric Vehiclesa", International Journal of Automotive Technology, 21(2), pp.51-52. DOI: 10.1007/s12239-020-0049-0

[2] Wei Liu, Hongzhong Qi, Xintian Liu, & Yansong Wang. (2019) "Evaluation of Regenerative Braking Based on Single-Pedal Control for Electric Vehicles", Frontiers of Mechanical Engineering, 12(10), pp.5-7. DOI: 10.1007/s11465-019-0546-x

[3] L. Han, X.-F. Han, X.-P. Ou, & Y. Guo. (2019) "Operating Performances Analysis of Brushless Doubly-Fed Machine Using Magnetic Equivalent Circuit, Dianji yu Kongzhi Xuebao/Electric Machines and Control, 23(1), pp.27-34.

[4] Zadid Khan, Sakib Mahmud Khan, Mashrur Chowdhury, Ilya Safro, & Hayato Ushijima-Mwesigwa. (2019) "Wireless Charging Utility Maximization and Intersection Control Delay Minimization Framework for Electric Vehicles", Computer-Aided Civil and Infrastructure Engineering, 13(1), pp.11-12.

[5] Dawei Pi, Qing Cheng, Boyuan Xie, Hongliang Wang, & Xianhui Wang. (2019) "A Novel Pneumatic Brake Pressure Control Algorithm for Regenerative Braking System of Electric Commercial Trucks", IEEE Access, 5(99), pp.1-1. DOI: 10.1109/ACCESS.2019.2924739

[6] Alberto Cavallo, Antonio Russo, & Giacomo Canciello. (2019) "Hierarchical Control for Generator and Battery in the More Electric Aircraft", Sciece China. Information Sciences, 62(9), pp.15-16.

[7] Magiera, A. (2017) "Control of Systematic Uncertainties in the Storage Ring Search for an Electric Dipole Moment by Measuring the Electric Quadrupole Moment, Dianji yu Kongzhi Xuebao/Electric Machines and Control, 20(9), pp.17-20. DOI: 10.1103/PhysRevAccelBeams.20.094001

[8] Diao, L., Jing, T., Loh, P. C., Yin, S. B., Lei, W., & Liu, Z. G. (2018) "An Efficient Dsp-Fpga-Based Implementation of Hybrid Pwm for Electric Rail Traction Induction Motor Control, Computer-Aided Civil and Infrastructure Engineering, 33(4), pp.32-38.

[9] Pavković, Danijel; Cipek, Mihael; Kljaić, Zdenko, Mlinarić, & Tomislav-Josip; Hrgetić. (2018) "Damping Optimum-Based Design of Control Strategy Suitable for Battery/Ultracapacitor Electric Vehicles, Energies, 21(2), pp.1-2.

[10] Guohui Zheng, San-Huang Ke, Maosheng Miao, Jinwoong Kim, & Nicholas Kioussis. (2017) "Electric Field Control of Magnetization Direction Across the Antiferromagnetic to Ferromagnetic Transition, Scientific Reports, 7(1), pp.53-66.

[11] Jinghua Guo, Yugong Luo, Jingyao Wang, Keqiang Li, & Tao Chen. (2019) "An adaptive Cascade Trajectory Tracking Control for Over-Actuated Autonomous Electric Vehicles with Input Saturation", Science China Technological Sciences, 10(8), pp.4-6. DOI: 10.1007/s11431-018-9445-3

[12] X. Zhao, K. Peng, X. Zhang, Y. Chen, & Y. Guo. (2019) "Stability and Optimal Control of Multi-Terminal Flexible dc Distribution System Under Master-Slave Control Mode, Electric Power Automation Equipment, 2(7), pp.10-12.

[13] Osamu Yatsubo, Shota Miyake, & Nozomu Takada. (2018) "Technologies for Estimation and Forecasting of Photovoltaic Generation Output Supporting Stable Operation of Electric Power System, Ieej Transactions on Electrical & Electronic Engineering, 13(3), pp.1-2.

[14] P.-H. Tian, & J. Xu. (2018) "Design and Realization of Control System Based on Stepper Motion Driven by PLC for Limiter Displacement on hl-2a Tokamak", Hejubian Yu Dengliziti Wuli/Nuclear Fusion and Plasma Physics, 38(4), pp.42-43.

[15] Wang, C., Liu, M., Aidong, X. U., & Zhang, J. (2017), "The Application of PLC Control System in Oil and Gas Pipeline Transportation", 8(Supplement 1), 8(4), pp.13-17.

[16] SHI Lang-feng. (2015), "Research on the PLC Control System Based on the Multistorey Parking Garage of the Intelligent Community", Value Engineering, 10(14), pp.3-4.

[17] Haijun Yu, Guofu Li, Liping Duo, Yuqi Jin, & Shukai Tang. (2015) "Data Acquisition and Control System with a Programmable Logic Controller (plc) for a Pulsed Chemical Oxygen-Iodine Laser", Proceedings of SPIE - The International Society for Optical Engineering, 1(4), pp.13-14.

[18] Du, Y., Wang, C., Yang, T., & Zhang, B. (2016) "Design of Constant Tension Controlling System Based on PLC in Warping Machine", Ieej Transactions on Electrical & Electronic Engineering, 15(8), pp.14-15.

[19] ZHANG Liang, HAN Yan-jun, WANG Yan-li, & Shijiazhuang Tiedao University. (2016) "Design of Pneumatic Deshuttering Manipulator Control System Based on PLC", Chinese Hydraulics & Pneumatics,6(10), pp.23-24.

[20] Zhu, H., He, J., Fang, W., Ye, D., & Liang, S. (2017), "Design and Test of Small Fresh Lotus Seed Sheller", Electric Power Automation Equipment, 33(7), pp.28-35.