Development and Application of Intelligent Integrated Tobacco Station

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Abstract—The tobacco industry plays an important role in China's agricultural economy. It is of great significance to standardize the process of tobacco quality inspection and grading. Aiming at this problem, this paper designs the process and flow of intelligent classification and automatic subcontracting of tobacco leaves. Based on this design, the intelligent classification and automatic transportation and packaging production line of tobacco leaves and the control system based on s7-1200 PLC are built. The intelligent classification of tobacco leaves adopts the method of combining spectral technology and machine vision technology, and determines the grade of tobacco leaves according to factors such as the color of tobacco leaves, the proportion of green and impurities. According to the classification results, it is automatically transported and packaged, and the design and development of the intelligent integrated smoke station system is completed.

Keywords-Tobacco grading; Spectral technology; machine vision; Control system design; S7-1200PLC

1 INTRODUCTION

The tobacco industry occupies an important position in China's agricultural economy, and the quality of tobacco leaves is the basis for the survival of the tobacco industry. Its quality grade directly affects the quality of tobacco products. Therefore, the quality of tobacco leaves must be graded and classified in actual production. At present, most of the world's largest flue-cured tobacco producing countries mainly use manual processing at the grading and purchasing end of tobacco leaves. This mode mainly judges the tobacco leaves subjectively through the experience of the staff and the sensory perceptions of the tobacco leaf graders, such as eyes, nose, and hands. It is relatively strong and relies heavily on workers' personal skills and experience, which makes the classification results less standardized and objective [1-2].

Therefore, it is of great significance to strictly regulate the quality inspection and grading process of tobacco leaves. In response to this problem, in recent years, there have been many studies using artificial intelligence technology to replace manual grading. Among them, the classification method based on machine vision technology is the most widely used [3-4]. By extracting the surface features of tobacco leaves, the color, shape, texture and other characteristics of tobacco leaves are used as the grading credentials. Using deep learning

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methods, the classification of tobacco leaf images can be obtained. Model. In addition, the research on automatic classification of tobacco leaves based on spectral technology [5] is also developing rapidly. This method first needs to combine hyperspectral cameras or detectors to obtain hyperspectral data of tobacco leaves with hundreds of channels, so as to obtain tobacco leaf classification by screening spectral features. Model. Spectral technology has the characteristics of fast, simple, and non-destructive. Compared with machine vision technology, spectral technology is more reliable in the application of tobacco leaf grading [6]. Aiming at the problems existing in manual grading and grading, this paper studies the grading of tobacco leaves by applying modern testing technology, and designs an intelligent integrated tobacco station that can realize grading of tobacco leaves, detection of moisture and impurities, weighing, compression and packaging. The realization of the intelligent acquisition of tobacco leaves has laid a solid foundation.

2 PRINCIPLE OF TOBACCO INTELLIGENT GRADING

Using aerospace military-grade hyperspectral imaging scanners, multi-dimensional sampling of tobacco leaves' spectral characteristics and image characteristics, through HSV color space inversion, convolutional neural network machine deep learning and other technologies, automatically identify the proportion of green and impurity in tobacco leaves, and predict Tobacco leaf grade, and record grading acquisition information.

2.1 Hyperspectral camera selection

The hyperspectral camera is selected by Gaia Field. The high-resolution imaging spectrometer covers visible light and near-infrared, and can provide more than 700 spectral channels in the whole waveband, which can be freely selected. In the visible light band, the spectral resolution is better than 3nm, even in the short-wave infrared band, it can reach 5nm. Therefore, more than 700 spectral channels can be obtained in the whole waveband (400-1000nm), and more spectral channels mean more information. Through the analysis and inversion of continuous spectra, more high-value data details can be obtained. The camera parameters are shown in Table 1.

Table 1 Gaia Field Camera parameters

Scanning mode	Built in push broom
Spectral range	400-1000 nm
spectral resolution	3.5 nm
numerical aperture	F/2.8
detector	CCD
Number of pixels	1392*1040(Spatial * Spectral dimension)
scanning speed	15 s/cube

2.2 Tobacco Grading Process

Tobacco grading is mainly divided into three parts: ①Collection and preprocessing: collect spectral data of tobacco leaves, standardize and correct the collected data through a whiteboard, and use image recognition technology to remove data interference such as background color and fragmented tobacco leaves. ②Green and miscellaneous detection: Based on the HSV color

space inversion technology, the normal, green and miscellaneous tobacco leaves are distinguished by hue, and the ratio of green and miscellaneous tobacco leaves is calculated to determine whether the tobacco leaves are qualified. ③Auxiliary grading: Machine learning is carried out through the dual-weight kernel extreme value learning method [7], and the mapping relationship between tobacco leaf hyperspectral data and tobacco leaf grade is established. The feedback is used to calibrate the model and continuously improve the classification accuracy. The grading method of tobacco leaves is shown in Figure 1.

2.3 Experimental effect

The detection of green impurities is mainly screened by analyzing the spectral channel, so as to obtain the percentage of green impurities and impurities. If the impurity ratio exceeds 20%, it is unqualified. After the green miscellaneous detection, combined with the near-infrared detector to determine a number of tobacco indicators, the qualified tobacco is then graded using the deep learning method, some green impurities detection results and some of the grading results are shown in Figure 2.

3 OVERALL DESIGN OF INTELLIGENT INTEGRATED TOBACCO STATION

Figure 3 shows the process flow diagram of the intelligent grading and automatic subcontracting system of tobacco leaves. It is mainly divided into two main processes: testing and grading and packaging and warehousing: ①Tobacco leaf testing and grading section: The function mainly includes two parts: conveying unit and testing unit. Processes such as weight measurement, automatic settlement, and level-by-level caching. The detection unit detects and grades tobacco leaves according to their characteristics. ②Automatic packing and warehousing section: The function is mainly based on the specification of 40kg each, using automatic weighing, automatic compression and packing equipment to realize automatic packaging processes such as tobacco leaf packing, compression and packing.

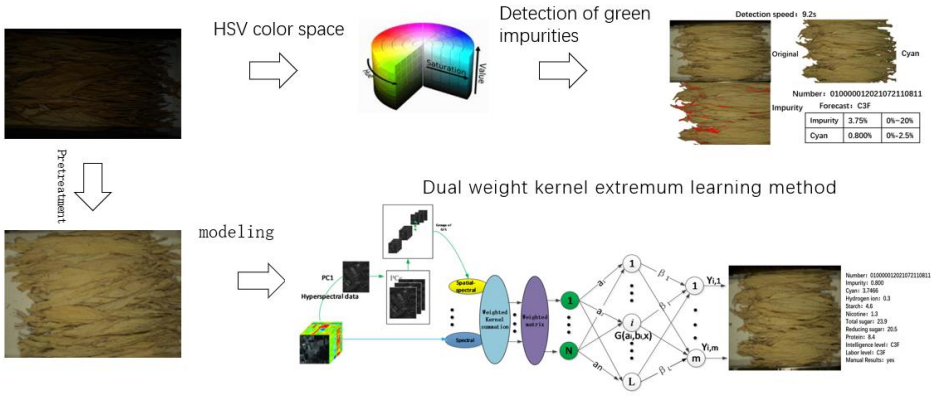


Figure 1 tobacco grading method

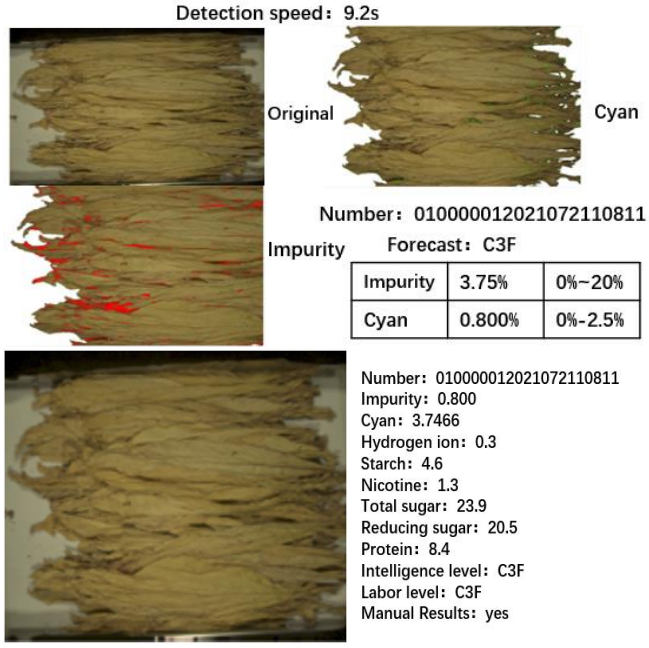


Figure 2 detection results of green impurities and tobacco grading results

3.1 Abbreviations and Acronyms

The overall layout of the automatic tobacco grading automatic production line is shown in Figure 4. The whole is divided into three large parts, grading part, conveying part, and packing part. The tobacco intelligent grading line is designed according to the intelligent automatic line standard. The line assists the AI grading system to realize intelligent grading, and automatically completes the process according to the automatic grading results, including removal of green impurities, weighing, classification by grade, layered stacking, and weight-based stacking. Compression packaging, packing belt strapping all process. The conveying process is single-line conveying. After grading, it is converted into four-line parallel conveying of four grades of materials. After the grade line completes the weighing and stacking, the conveying process is merged into the single-line compression packing line in the latter section.

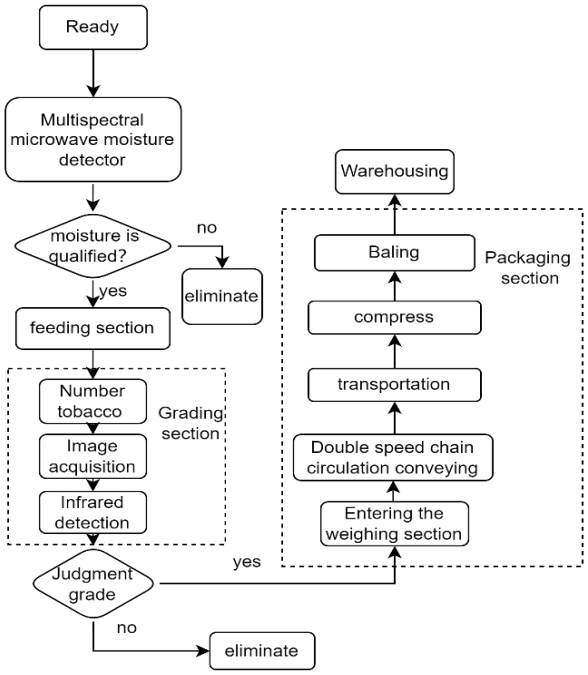
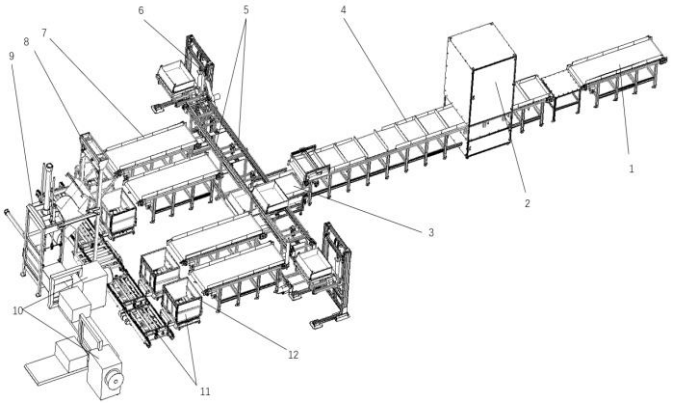


Figure 3 Technological process



1. Feeding belt 2. Hyperspectral camera 3. Weighing belt

4. Grading section conveyor belt

5. Double layer drive double speed chain

6. Hopper lifting mechanism7. Graded conveyor belt

8. Bin lifting mechanism 9. Tobacco leaf compression mechanism 10. Baler 11. Bin conveying mechanism 12. Bin

Figure 4 Planar Configuration Diagram

4 DESIGN OF INTELLIGENT INTEGRATED SMOKE STATION CONTROL SYSTEM

4.1 Overall design of control system

The overall design of control system mainly includes conveyor belt conveying control, tobacco leaf grading system control, gas-liquid transmission control and baler control. The control system takes S7-1200 PLC as the core, the HMI monitors and controls the operation of the entire control system, and controls the motor, cylinder and other equipment with proximity switches and other components to make the conveyor line complete the corresponding action.

4.2 Control System Hardware Design

The hardware design of the intelligent integrated smoke station control system is shown in Figure 5. PLC selects CPU 1214C, PLC is responsible for controlling the three-phase asynchronous motor of the conveyor belt, and cooperates with the proximity switch to complete the corresponding action. The upper computer accepts the information collected by the hyperspectral camera and the motor of the near-infrared physical and chemical index detector, analyzes the data, and realizes the grading of tobacco leaves. Send the classification result to the PLC. Then operate the PLC through the 8102IE touch screen to control the asynchronous motor to carry out the rejection of unqualified tobacco.

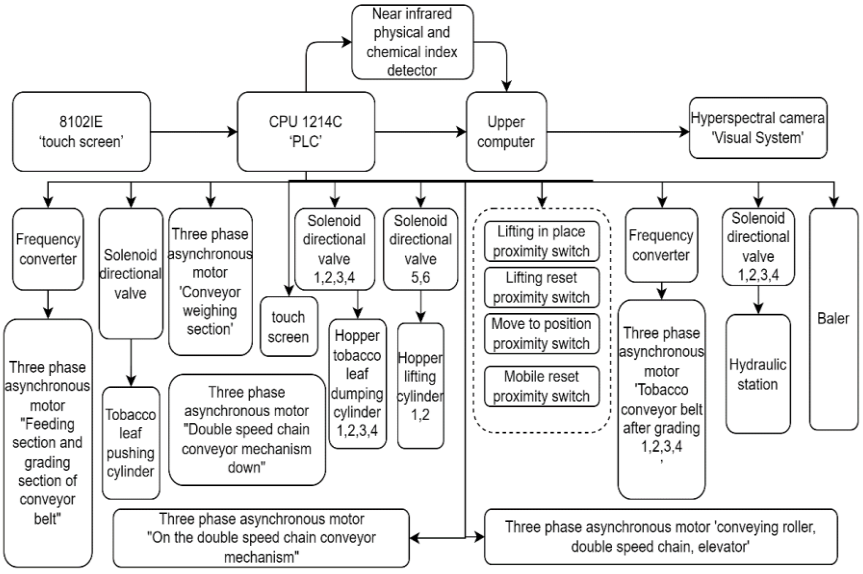


Figure 5 Hardware selection of control system

5 DESIGN OF INTELLIGENT INTEGRATED SMOKE STATION CONTROL SYSTEM

This study was applied to a tobacco monopoly bureau for the construction of an automatic line for automatic purchase of tobacco leaves. It was oriented to tobacco quality inspection and the whole process of packaging was automated. It overturned the previous inefficient production methods of manual sorting and grading and packaging, and achieved excellent results. The intelligent integrated smoke station has achieved good benefits: the automated production line has changed the traditional manual discrete production method; the material handling volume and manual operation time have been greatly reduced, the labor intensity has been reduced, and the overall production efficiency has increased by more than 90%. Tobacco quality inspection, the whole process of production from packaging to finished product storage; tobacco leaf acquisition is significantly faster and easier to advance, and workshop acquisition planning and production organization management are easier; sorting personnel are reduced by more than 90%, and the average annual production cost is reduced by more than 80%. The scene is shown in Figure 6.

The improvement of production efficiency is mainly reflected in the following three aspects: ① The number of production personnel: 100 or more people were originally needed, but now only 10 people are needed, reducing labor costs by 90%; ② Production efficiency: 0.15t tobacco leaf can be purchased in one day (calculated by 8 hours), but now about 1.5t tobacco leaf can be purchased. A 90% increase in efficiency can produce 40% benefit; ③ Quality consistency: It ensures the product quality, avoids the mixing of different grades of tobacco, reduces the cost of regrading due to grading errors, and can improve the efficiency by 10%.

Figure 6 field application example of equipment

6 CONCLUSIONS

This paper analyzes the problem of automatic grading of tobacco leaves, adopts the intelligent grading method based on spectral technology and machine vision, and completes the process of removing green impurities, weighing, classifying by grade, layering, stacking by weight, compressing and packing. The key technological processes such as bagging, packing and strapping have been applied in the acquisition practice, realizing the whole process of automatic grading of tobacco leaves and automatic packaging according to levels, which improves the

efficiency of acquisition, reduces production costs, and reduces the impact of human factors on the classification of tobacco leaves. influence, and achieved good application results.

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