Research and Development of An Intelligent Beer Brewing Monitoring Based on Video Analysis

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Abstract: As the brewing industry enters a new era, developing high quality has become an essential task today. Based on the video analysis technology of deep learning, this paper aims to develop an intelligent beer brewing monitoring system to meet the quality and efficiency requirements of the beer brewing process. Through the video analysis test platform, we successfully built a video analysis model. In addition, we have established a signal acquisition system and video analysis circuit to identify and classify raw materials and brewing equipment, as well as to detect and identify parameters and conditions. The experimental results show that the intelligent beer brewing monitoring system based on video analysis has high accuracy and practicability. It can help identify and classify key ingredients in the brewing process and also monitor and identify changes in process parameters, thereby improving quality and efficiency. However, we also recognize the limitations of video analysis models and the room for improvement in signal acquisition systems and video analysis circuits. Therefore, we emphasize further optimization of the model and collaborative integration of the system to better meet the needs of the beer brewing industry. To sum up, this paper provides an advanced monitoring system for the beer brewing industry through the application of video analysis, which is expected to help improve the quality and efficiency of beer brewing, promote the industry to move towards high-quality goals, and meet the needs of the industry.

1. Introduction

Intelligent beer brewing monitoring is one of the main responsibilities of the beer brewing industry, and it is also an important system for the beer brewing process. It can be divided into basic monitoring and non-basic monitoring, which is composed of video analysis and data acquisition. To improve the quality and efficiency of beer brewing, managers entrust intelligent monitoring systems for real-time production process monitoring and quality evaluation. Since the beer brewing industry entered a new era, intelligent monitoring has become the key to beer brewing production. The data becomes an evaluation index. Different from traditional beer brewing monitoring, the intelligent monitoring system attaches importance to the application of data analysis, deep learning, and video analysis technology. Therefore, we propose the topic of intelligent beer brewing monitoring based on video analysis. Deep learning provides a technical means for the beer brewing industry.

The intelligent beer brewing monitoring system originates from beer brewing production with advanced technology as the core. The monitoring function contains advanced technology and is also a tool for supervising the brewing process [1]. From the perspective of the structure of the monitoring system, it pursues real-time monitoring. It realizes the modernization of beer brewing and production through video analysis and data acquisition. However, it is only in the early stages. Today, the monitoring system has implemented an innovative way. The comprehensive promotion not only changes beer production methods and demonstrates scientific and technological innovation but also changes the entire industrial model and has a positive impact on beer production quality and efficiency. Therefore, when discussing the intelligent beer brewing monitoring system based on video analysis, we must have a macro vision and overall pattern. We proposed the proposition of

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quality and efficiency in developing intelligent monitoring systems.

In short, the intelligent beer brewing monitoring system is an important condition and guarantee for the high-quality development of the brewing industry. From a development perspective, it has made progress, but there is room for improvement. The system still needs to find the most effective monitoring method and is working hard to progress. Therefore, intelligent monitoring needs to be continuously improved, and this is not only the responsibility of the beer industry but also a commitment to the market and consumers.

Based on the above background, this paper proposes an intelligent beer brewing monitoring system based on video analysis, aiming at improving the quality and efficiency of beer brewing. The key problems of beer brewing production are solved using deep learning theory and video analysis methods. The main contents include system construction and experimental results analysis, which effectively responds to production risks and has important practical significance.

2. Video Analysis Test Platform and Method Based on Deep Learning

2.1 Experimental Samples and Models for Video Analysis

In the research process of video analysis, the basic data collection was considered. At the same time, the application of the deep learning model was neglected, which led to inaccurate video analysis research and poor optimization effects. Based on the above, we have conducted deep learning research on video analysis. The research content includes video analysis and analysis of the performance indicators of the model so that the monitoring effect is more excellent.

First, we conducted a detailed study of the experimental samples of video analysis and collected and organized rich video data to meet the needs of deep learning models. Second, we select appropriate deep learning models, including convolutional neural networks (CNN) and recurrent neural networks (RNN), to build effective video analysis models [2]. Then, we explain the training strategy and parameter adjustment of the model to further improve the performance of the model. Finally, through many experimental verification and performance evaluations, we verify the excellent effect of video analysis in monitoring.

Based on the analysis of the above indicators, this section conducts a detailed study of video analysis. The results show that applying deep learning models has achieved remarkable results in video analysis and has important value for beer brewing monitoring.

2.2 Signal Acquisition System and Video Analysis Circuit

The signal acquisition system and video analysis circuit are concepts developed with video analytics linked to the intelligent surveillance system [3]. It highlights real-time data acquisition and reflects the beer brewing industry's strategy of attaching importance to quality and efficiency. However, when we use some standards to construct the definition and essence of video analysis circuit and signal acquisition system, it can be challenging to get a clear definition.

First, the video analysis circuit is a multi-level data processing system that aims to analyze and provide feedback on video data in real time. Its structure covers video capture, preprocessing, feature extraction, and model inference to ensure high-quality monitoring. The signal acquisition system is responsible for obtaining real-time sensor data, such as temperature and humidity, for monitoring the process parameters in the beer brewing process.

However, the boundaries and connotations of video analysis circuits and signal acquisition systems may vary in different environments, so their exact definition needs to be precisely defined based on specific applications and needs. The development of these systems is crucial to the improvement of the quality and efficiency of beer brewing industry, but more research and practice are needed in practical applications to clarify its optimization strategy. The video analysis circuit and signal acquisition system are shown in Figure 1.

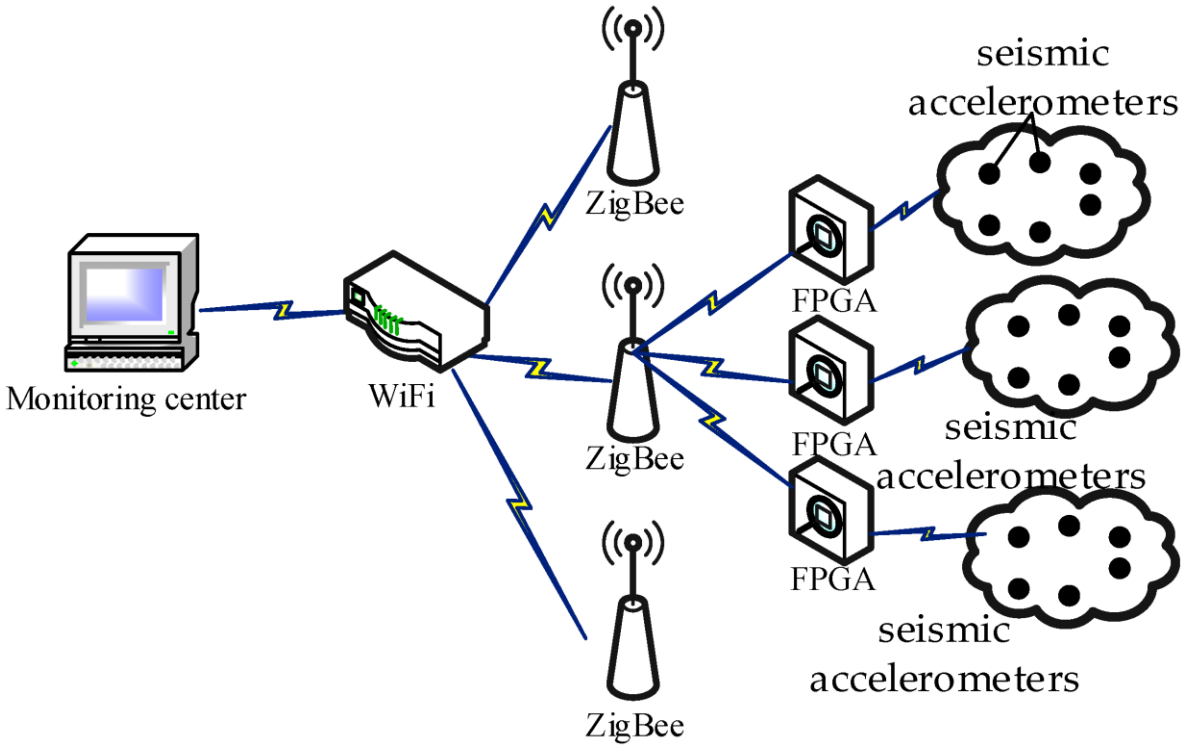

Figure 1 Video analysis circuit and signal acquisition system

2.3 Video Analysis Test Methods

Compared with traditional analysis methods, video analysis testing methods emphasize the relationship between testing and data and have the characteristics of being real-time and verifiable. Some scholars have questioned that the experiment may not directly relate to data analysis. Still, most scholars advocate that the experimental method can rationally evaluate the effect of video analysis. Smith et al. proposed a classical experimental model for video analysis with multiple experimental elements, which has since become a typical tool for video analysis. [4] Academics consider experimental methods highly reproducible and part of the truth. When the experimental method is standardized and scientific, video analysis will be accurate.

In addition, scholars have summarized the experimental methods into two models, namely, the experimental model based on monitoring data and the experimental model based on deep learning. The former focuses on data collection, and the latter focuses on model training. Although the experimental method has experienced some challenges and failures, it provides strong support for video analysis from the perspective of quality and efficiency. As a result, experiments have gradually become a common method for video analysis research and practice.

3. Video Analysis Test Results

3.1 Identification and Classification Results of Beer Brewing Raw Materials and Equipment

The quality is an important criterion for the identification and classification of raw materials and equipment, and it is the effect expression of the production of beer brewing. Quality and accuracy affect the identification and classification of raw materials and equipment from different aspects [5]. Some scholars believe that quality is the degree of identification and classification of beer brewing raw materials and equipment, or credibility. Because quality is more measurable to some extent, it belongs to the result-oriented monitoring ways.

Quality monitoring can even be traced back to the origin of beer brewing, and its main activities include supervision of the brewing process, product production, and management [6]. Quality and standards are closely related to the output of beer brewing products. Through the identification and classification of raw materials and equipment of beer brewing, quality has become an important

factor in beer brewing production. The main contribution of this theory is the continuous improvement of monitoring technology. Therefore, the original concept of quality focused on measuring results based on data. The identification and classification results of the raw materials and equipment are shown in Figure 2.

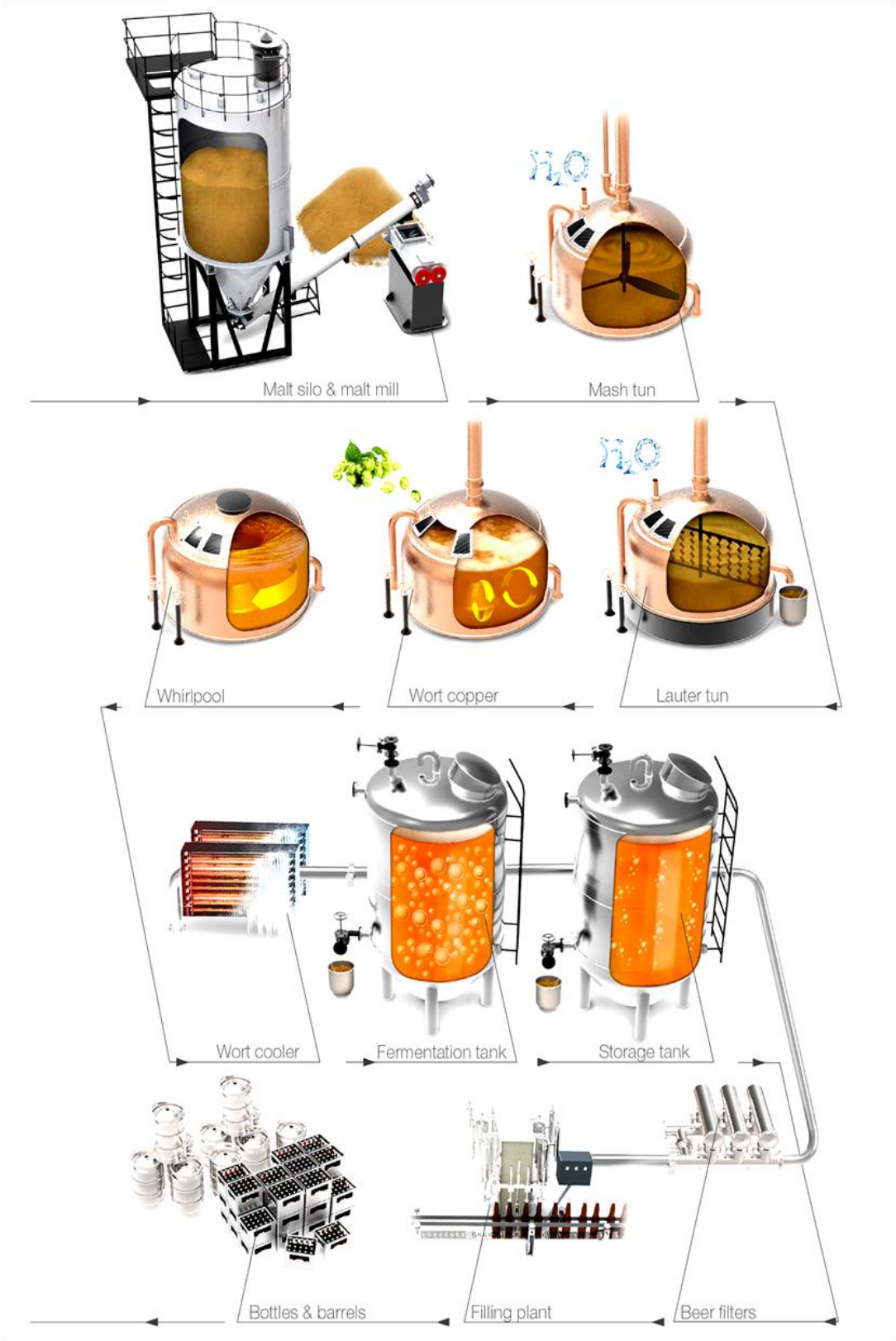

Figure 2 The identification and classification results of the raw materials and equipment

In the experiment, the identification and classification of raw materials and equipment is one of the important indexes of quality evaluation, which reflects the performance and accuracy of the

monitoring system in practical application. Through the experimental results, we can better understand the relationship between quality and efficiency to further improve beer brewing production.

3.2 Detection and Identification of Beer Brewing Process Parameters and Process Status

We focus on monitoring beer production process parameters and providing process status identification and detection results. The way used is applying intelligent monitoring system thinking in beer brewing production. To overcome the shortcomings of manual monitoring, it has entered the research field as an intelligent monitoring framework. The basic idea of the framework is as follows. First, the monitoring should ensure the brewing process parameters and process status. Second, set professional standards for product output. Third, the production process is recorded by real-time data. Fourth, researchers use deep learning to measure quality and efficiency.

The intelligent monitoring framework reconstructs beer brewing production, emphasizes real-time performance, and improves the repeatability, verifiability, and regulation of monitoring. Through the detection and identification results of beer brewing process parameters and process status, we can better understand the effect of brewing production to further improve the quality and efficiency of beer brewing [7]. This framework is expected to lead the intelligent monitoring system to develop with high quality, build a more reliable monitoring system, and meet the needs of the brewing industry. The detection and identification results of process parameters and process status are shown in Figure 3.

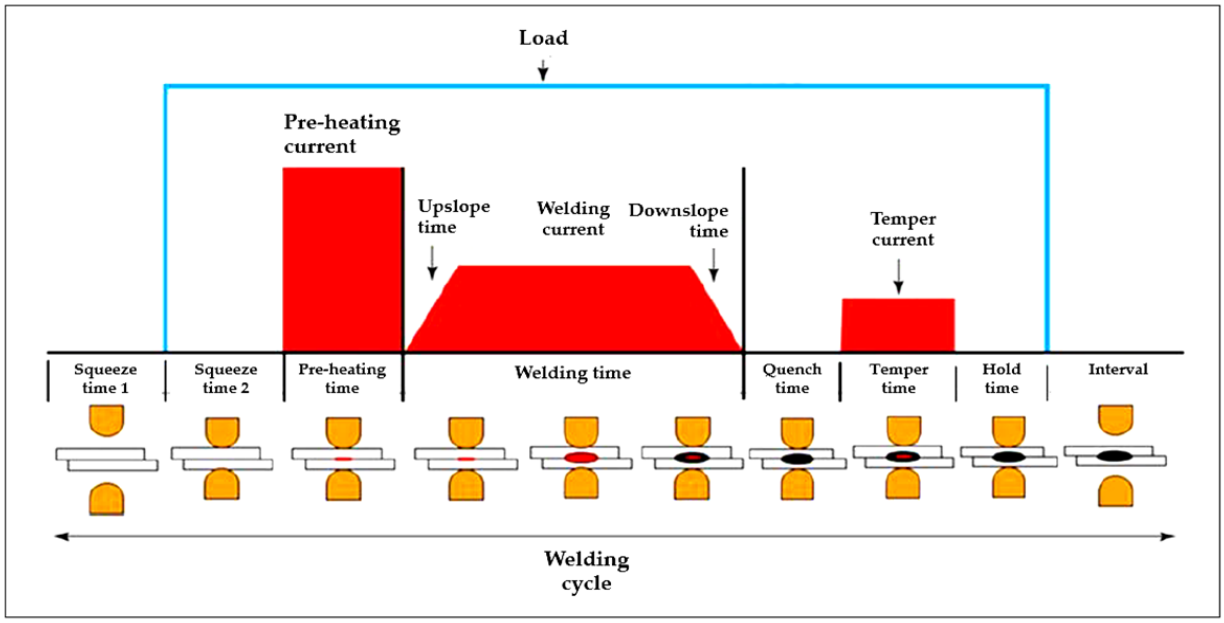

Figure 3 The detection and identification results of process parameters and process status

4. Discussion Based on Video Analysis Experiment

4.1 Advantages and Limitations of Video Analysis Models

Video analysis is the main component of the intelligent monitoring system, which focuses on the system's intelligence. We use deep learning technology to directly reflect the monitoring and process status of beer brewing raw materials and equipment [8]. Some elements of developing the video analysis model are gradually being formed, and the model performance and evaluation system are gradually being valued. However, from the perspective of the application, the practice of some video analysis models stays in the primary stage, which is contrary to the logical framework and generation mechanism of intelligent monitoring systems. Therefore, we study the advantages and limitations of the model.

The advantages of the video analysis model are that it can realize real-time monitoring, reduce manual intervention, and improve monitoring efficiency. At the same time, using deep learning, the

model will automatically adapt to different production scenarios and have a wide range of application prospects. However, the limitation of the model is that it requires a large amount of sample data for training, and the model's performance is highly dependent on data quality. Furthermore, we must constantly optimize and update to adapt to new production conditions, so the maintenance cost is high. In addition, the interpretability of the model needs to be improved to better cope with the anomalies and problems in beer brewing. Therefore, developing a video analytics model requires more research and practice to overcome its limitations and achieve better monitoring results.

4.2 Collaboration and Fusion of Video Analysis Circuit and Signal Acquisition System

From the perspective of video analysis, a video analysis circuit is the basic link of an intelligent monitoring system and the core embodiment of data acquisition. Therefore, video analysis takes signal acquisition as the main generation logic. The video analysis circuit is the main data processing body of the monitoring system. At this stage, video analysis strengthens the cooperation between video analysis circuits and signal acquisition systems from collaboration and integration. There are three main forms: the first is data exchange. It enables data to interact between video analysis and signal acquisition. The second is the standard setting. By formulating data format standards and communication protocol standards and disclosing them to monitoring equipment, standardized data control is realized. The third is process reengineering. In recent years, data acquisition equipment has used advanced technology to improve data acquisition efficiency and data quality. However, compared with intelligent surveillance systems, the collaboration and integration of video analysis still need to be further improved. More research and practice are needed to promote the collaboration and integration between video analysis circuits and signal acquisition systems to achieve better monitoring results. The collaboration and integration architecture of the signal acquisition system and the video analysis circuit are shown in Figure 4.

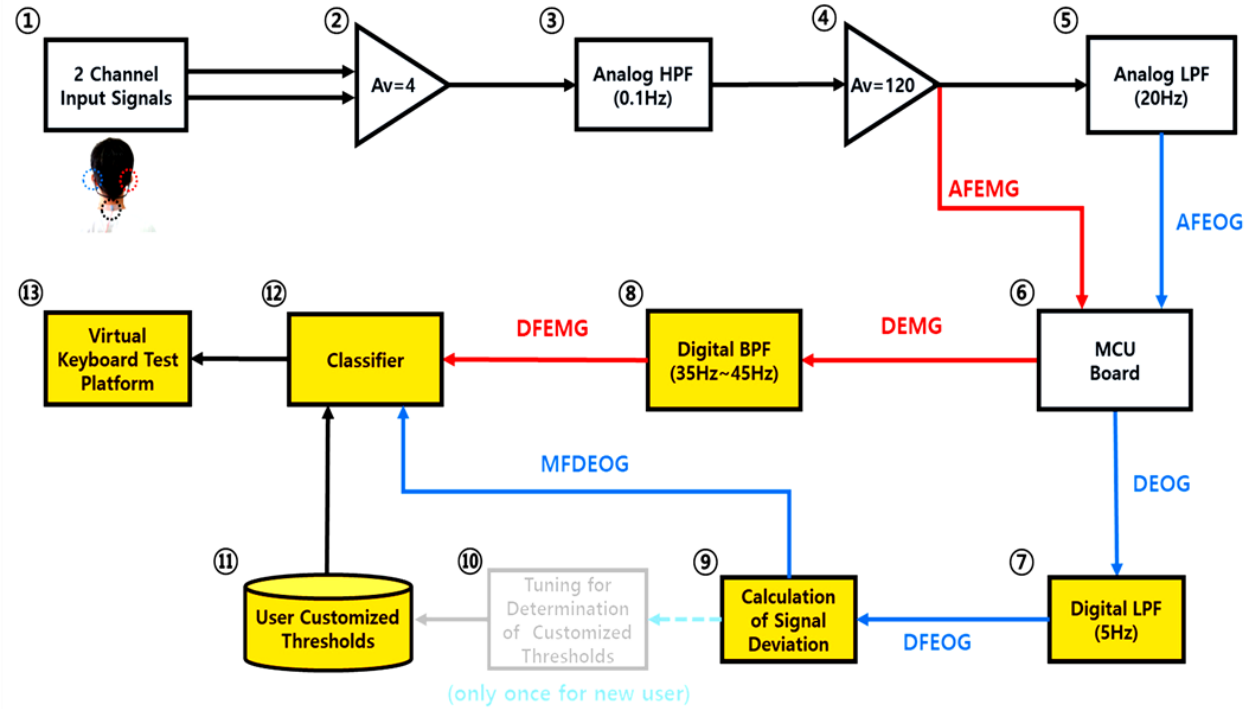

Figure 4 The collaboration and integration architecture of the signal acquisition system and the video analysis circuit

4.3 The Impact of Experiments on Beer Brewing Quality and Efficiency

This paper proposes a method for controlling beer production quality and efficiency based on video analysis. By the image processing ability of video, the parameters such as temperature, acidity, and sugar content in the beer brewing process are transformed into images. The deep neural network model is trained to realize the accurate monitoring of the parameters. To verify the

effectiveness of this method, this paper uses MATLAB as the simulation platform to generate video data of different types, locations, and lighting conditions. It uses it as the input of the neural network model. The simulation results show that it can realize the real-time monitoring of beer brewing parameters in complex environments and has good stability and generalization ability. The deep neural network is a multi-level nonlinear model used to extract features from video data and classify them in this research. The function of the deep neural network is expressed as follows:

$$f(x) = W_L \sigma(W_{L-1} \sigma(...W_1 \sigma(x + b_1)...) + b_{L-1}) + b_L \quad (1)$$

In the formula, x is the input video data, W_i and b_i are the weight matrix and bias vector of the i-th layer, σ is the activation function, L is the number of network layers, and $f(x)$ is the output parameter.

5. Conclusion

Intelligent monitoring has become the realistic demand of the beer brewing industry, which puts forward challenges and requirements for the quality and efficiency of beer brewing. Intelligent monitoring is the symbol of "intelligence" in the beer brewing industry and is an important means of production. Furthermore, there is an urgent need for quality control and maintenance efficiency, reflecting the inherent requirements of the industry. Due to the progress of science and technology, people construct the theoretical analysis framework and practical mechanism of intelligent monitoring. In recent years, modern information technologies such as deep learning have promoted the development of intelligent monitoring, improving the accuracy of monitoring systems and models through data analysis. The research value conforms to the internal logic of the beer brewing industry. Therefore, video analysis also provides a new way for beer brewing quality and efficiency. In conclusion, the sustainable improvement and development of intelligent monitoring can help to meet the needs of the industry and promote the high-quality development of the beer brewing industry.

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