ABSTRACT

In this paper, based on the construction of college cafeteria facilities, the current status and innovation designs of cafeteria facilities are analyzed, and the functional defect and innovative design of college cafeteria facilities are discussed to propose the concept of automation-based design of cafeteria facilities with empirical study provided, which provides a new idea for the design of college cafeterias.

KEYWORDS

College cafeteria; Facility; Multifunction; Automation.

PREFACE

With the rapid development of education, number of enrolled students increases; therefore, college cafeterias shall be expanded continuously to meet the dining needs of more people and higher requirements of teachers and students. College cafeteria is also an important part of catering industry of China and plays an important role in logistical support. Cafeteria facility plays an essential role in dining process of teachers and students, it directly impacts the sanitary condition and availability of tableware and the overall environment of the cafeteria etc. In addition, the using experience of cafeteria facilities influences the dining mood and satisfaction toward college cafeterias of teachers and students [1]. Therefore, the introduction of automation in design of college cafeteria facilities can help to realize efficient operation of facilities and improve dining efficiency of teachers and students and prevent crowding in cafeteria. Therefore, improving the level of automation of college cafeteria facilities is of great importance [2].

CURRENT STATUS ANALYSIS OF CAFETERIA FACILITY DESIGN

Cafeteria facility is an important part in cafeteria infrastructure construction; the analysis and improvement of college cafeteria can not only enhance construction of cafeteria infrastructure, but also improve the dining environment and the overall...
Potential Safety Hazard during Use

First, Cafeteria facilities are featured by long-term repeated uses. In college cafeterias, large amount of foods and dishes were cooked to meet teachers’ and students’ needs, and the kitchenware and tableware are used for many times every day. In recent years, the government is attaching increasing importance to safety, and colleges’ consciousness in the safe use of cafeteria gas and electrical equipment are enhanced. However, the safety issues in tableware related hardware are not attached importance to by managers. Due to absence of effective control measures of hazards in cafeteria hardware, burning, scratching and tumble due to safety hazards of hardware equipment are commonly seen [4].

Unqualified Hygienic Condition

Currently, colleges have relevant backward management system in cafeteria sanitary control, and the number of cafeteria sterilization and disinfection equipment are limited. Although some college cafeterias have disinfection and disinfection management system, but such systems are mainly for necessary cleaning of dining environment and tableware disinfection measures is merely implemented [5].

Incomplete sterilization of cafeteria tableware’s is very likely to cause diners’ exposure to viruses and other organisms, which causes foodborne diseases. It is found through reviewing of literatures that, among other tableware’s, the disinfection qualification rate of chopsticks is the lowest; the storage mode of chopsticks is mainly to be blamed: the cleaned chopsticks are stored without drying or stored in a box without cover rather than a dedicated storage device, and incomplete cleaning of boxes causes secondary pollution of chopsticks [5].

Operation Inconvenience

With the fast growth of enrollments, too many diners are dining in the cafeteria during peak hour, and the poorly designed storage facilities make it hard for diners to get the tableware’s. In addition, the tableware classification and sorting as well as cleaning of leftovers are carried out manually, which causes large amount of recovery works as well as low work efficiency, especially in peak hours, during which, large amount of tableware’s pile up, which makes in-time cleaning of leftovers impossible, and thus causes congestion and affects dining environment.

It can be seen from above-mentioned phenomenon that, currently, the number of cafeteria hardware in colleges is still insufficient, and this not only reduces the dining efficiency but also reduce the overall service quality of cafeteria. Moreover, more students will choose to eat outside of the school, and thus the profits of the cafeteria will be reduced. Therefore, to achieve sustainable development, college cafeterias must increase input to hardware facility to improve overall environment of the cafeterias and meet the requirement of social development [6].
DESIGN PRINCIPLES OF COLLEGE CAFETERIA HARDWARE FACILITIES

College cafeteria directly impact the working and studying of college teachers and students as well as the development of college [7]. To improve cafeteria service quality and construct civilized colleges, while providing cost-effective and delicious meals, effective utilization of cafeteria hardware facility is also a key factor. The effective utilization of cafeteria hardware can reduce the work load of staff and ease congestion in cafeteria during dining peak hour.

Safe Structure

Safe structure design of cafeteria facilities plays an important role in normal running of college cafeteria as well as the living quality of college students and teachers. The safety issue of facilities is the key point in college cafeteria work. Currently, accidents caused by poor structure design of cafeteria facilities are commonly seen. In terms of structure design, ventilation opening can be design for damp-proof purpose and ensure reasonable dryness; for equipment requiring waterproof design, the waterproof grade shall meet specified waterproof standards. In addition, the equipment shall have adequate mechanical strength to withstand possible physicochemical impacts when in use [8]. The principle of “safety first” shall be followed in the operation and development of college cafeterias, and any unsafe factors shall be found timely and eliminated during the operation of facilities [9]. For equipment with automatic operation system, safety shall be paid more attention to, to prevent safety accident of diners and ensure normal operation of cafeteria [10].

Multi-function

The function designs of existing facilities in college cafeterias are generally out of date. Most of chopstick boxes in college cafeterias only have storage function, and the incomplete disinfection of chopsticks causes bacterial infection, and poor accessibility of chopsticks causes’ congestion. Multi-functional and automatic chopstick box can integrate such functions as chopstick storage, high-efficient sterilization and drying as well as high accessibility. Therefore, the functions of cafeteria facilities must be enhanced using aesthetic and ergonomic principles and automatic design to meet using requirements [11].

Easy Operation

The existing college cafeteria facilities have great limitations. In order to reduce cost, most college cafeterias are still using the simplest designed equipment. The tableware sorting is carried out manually; this work is featured by difficulty in operation and low efficiency, and staff is very likely to get tired. Therefore, the easy operation of cafeteria staff and diners shall be considered during the design of cafeteria facility to enhance the operability of the facility and make contribution to improving cafeteria’s working efficiency. The design of cafeteria facility must give priority to the enjoyable dining of the diners to ease diners’ work load and pressure and to meet both their physical and mental needs [11].
Design Innovation

Currently, most college cafeterias are featured by simple structure, low degree of automation and merely storage function and less innovative functions [12]. Design innovation shall be considered while guaranteeing the automation of college cafeteria equipment, especially, the frequently used ones. Innovation not only refers to style innovation, but also function innovation. The innovation design of cafeteria facilities helps realizing multi-functions of equipment instead of simple structure design, and the automatic operation system guarantees the effective operation of the facility to reduce congestion during peak hours. On the other hand, functional innovation of equipment is an important premise for continuous development of cafeterias as well as the enhancing of emotional communication among teachers and students [2].

DESIGN CASE

College cafeteria is an important dining place for teachers and students, and the cafeteria facility impacts the overall environment of the cafeteria and is closely related to the health of diners [13]. In order to improve the dining environment and overall service quality of college cafeterias, in this paper, the design of cafeteria facilities is improved in terms of accessibility, function and innovation to design new automatic cafeteria facility.

Design of Multi-Functional Chopstick Box

With the rapid growth of college students in recent years, the factors impact the dining of college students become diversified [14]. Colleges need to increase input to cafeterias, especially to improve automation of cafeteria hardwares. In the design of automatic chopstick box, in addition to the accessibility of chopsticks by several students and teachers at the same time, the safety and disinfection function are fully considered to ease congestion significantly and create comfortable and elegant dining environment [15].
A chopstick box is featured by thorough disinfection and rapid drying function. After the cleaned chopsticks are put into the chopstick box, the drying and disinfection button shall be switched on to power on the infrared ray heating tube to evaporate the residual water on the chopsticks, and the exhaust fan will exhaust the vapor out from the box to ensure that the chopsticks keep dry for wet chopsticks are not only vulnerable to bacteria breeding but also kill the diners' mood; After the box is powered on, the infrared ray and ultraviolet ray will be generated to realize double disinfection and keep the chopsticks clean to prevent impact to diners' health by bacterial infection.

The chopstick box also has automatic chopsticks counting function. The number button set on the outer surface of the chopsticks box controls the number of chopsticks. Once the user pushes the number button, the internal micro-controller will
receive the signal and control the number of chopsticks through controlling of the contraction and expanding of spacer; this also guarantees rapid chopstick providing. The automatic chopsticks counting function of box not only ease operation and save diners’ time, but also meet varied needs of different persons and improve operation efficiency of cafeteria. In addition, the inclined chopstick outlet design ensures the chopstick end with greater diameter contact the bottom of receiving box with smaller diameter end points up, and the users contact the end with greater diameter to ensure the sanitation of chopsticks.

This multi-functional chopstick box can not only be easily operated and meet the needs of many people, but also has disinfection function that solve the existing problem of incomplete disinfection and slow drying of chopsticks. The chopstick box is made of corrosion resistant plates that are corrosion resistant and easily welded and manufactured with low cost.

**Design of Automatic Service Plate Collection and Cleaning Machine**

For the design of automatic service plate collection and cleaning machine, two factors are mainly considered, i.e. easy operation and hygiene to reduce cafeteria staff’s work load and prevent spattering of leftovers on floor, which causes personnel falling.

![Figure 3. Structure of Service Plate Collection Machine.](image-url)

1. Transferring box fixed on conveyor  
2. Main wheel of conveyor  
3. Groove on transferring box  
4. Division bar on transferring box  
5. Outer housing of operation box  
6. Rotary apparatus  
7. Clamping device fixed on rotary apparatus  
8. Waste food dumping  
9. rotary apparatus driving 6 and 7  
10. Cleaning box  
11. Slope of service plate collection box  
12. Service plate collection box  
13. Chopstick collection box  
14. Chopstick slope channel  
15. Waste liquid food collection box
The whole service plate collection and cleaning machine is mainly composed of six parts, i.e. conveyor, clamping device, cleaning box, service plate collection box, chopstick collection box and waste food collection box (Figure 1).

When a service plate is conveyed to the waste food dumping place by conveyor, the sensor on the clamping device will clamp the plate rapidly upon sensing the plate, then the leftovers in the plate will be dumped into the waste food collection box through rotation; after that, the plate will be put into cleaning box with high pressure sprayed water; During the rotation of plate, the oil residual is primarily cleaned, after that, then the plate is above the plate collection box, the clamping device will release the plate to place it on the slope and slip into the collection box. Meanwhile, the chopsticks in the groove will be conveyed to the slope channel by conveyor, and slip into chopstick collection box. By then, the automatic service plate collection and cleaning is completed.

This automatic service plate collection and cleaning machine can be operated easily, and can reduce the work load of cafeteria staff and diners significantly and ease congestion in cafeteria. In addition, the previously dirty, disorderedly status in service plate collection spot can be improved to create a good dining environment for students and teachers.

CONCLUSION

College cafeteria is the key project for infrastructure construction in colleges, and it directly impacts the work and living of teachers and students. Cafeteria facility construction is the key point for sustainable development and core competitiveness enhancing of cafeterias. The use of hardware facilities can reduce work pressure of cafeteria staff and improve dining efficiency of teachers and students significantly. Nowadays, the number of college students increases day by day, but the existing facilities are relatively backward, and many problems are found in use. Therefore, the automatic design of college cafeteria facilities is the premise for cafeterias to keep pace with the times [11].

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