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Water Hardware Maintenance Diagnosis System-- Taking Faucet Mixing-Cartridge Diagnosis as an Example

Sheng Yuan Hsu

Graduate Institute of Services and Technology Management,

Chienkuo Technology University,

Changhua, Taiwan, ROC

jackhsu@ctu.edu.tw

Abstract---In order to encourage Taiwanese people to DIY, install or repair faucets and other water hardware products by themselves, a water hardware maintenance diagnosis system will be developed in the study. People can purchase water hardware products by themselves and try to install and repair by themselves. The study attempts to build a faucet diagnosis system to help people quickly and correctly judge the problem of water hardware and obtain related key components for repairing. The decision-making model of the diagnostic system has been developed, and the platform of hardware DIY experts has been built. The model of water hardware DIY will be promoted and tested.

Index Terms—Water hardware, maintenance diagnosis system, Faucet mixing-cartridge

1. INTRODUCTION

The mixing-cartridge is the heart of the faucet, most of the main problems including water leakage, too much or too little water, etc, are all caused by the failure of the mixing-cartridge. If people can master the techniques of diagnosis and replacement of the key component of the faucet, most of the faucet problems can be killed by replacing the Mixing-cartridge. Therefore, mixing-cartridge replacement is the key parts of the DIY of faucet maintenance.

There are two types of mixing-cartridge, including ceramic mixing-cartridge and copper bolt in the water hardware industry. The specifications of mixing-cartridge ware well knew and limited. This study will try to build an identification system for those type of mixing-cartridge through summary analysis for public search and confirmation. In addition, through the development of the platform of hardware DIY experts, the people will be taught how to disassemble and install the mixing-cartridge, judge the type and specification of the key component, leading to purchase the suitable component online, and guide to DIY repair and replacement.

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Replacement and maintenance of mixing-cartridge DIY in the study is divided into three categories:

1. Know the brand of the faucet,
2. Have tools to disassemble and assemble the faucet,
3. Diagnosis system for the mixing-cartridge (for situations where the faucet cannot be disassembled and the brand cannot be identified).

These three types of DIY guidance, teaching, and shopping mechanisms will be constructed separately.

2. WATER HARDWARE MAINTENANCE DIAGNOSIS SYSTEM

When people want to DIY faucet repairs, if they can determine the brand of the faucet at home, they can find out the corresponding mixing-cartridge through the platform of hardware DIY experts platform. If the faucet brand cannot be identified, the people can try to disassemble the faucet following the guidance of the demonstration video on the platform, and then take out the mixing-cartridge to judge the type and specification of the parts, and carry out the DIY repair of the faucet successfully. If people cannot disassemble and assemble by themselves and cannot identify the brand, people can use the mixing-cartridge diagnostic system developed by the research to predict the specification of the mixing-cartridge.

The diagnostic system is based on the relevant information collected by this research, including about 440 products sold by major domestic brands in recent years, as well as faucet information collected through home interviews with 268 consumers (including: kitchen, bathroom sink and shower Faucets, etc.), and the interview summary of 30 manufacturers from Plumbing Association of Taiwan. Total of 1,244 types of faucets were included in the database, including 390 items of kitchen faucets, 457 items of bathroom sink faucets, and shower faucets 397 items. The data sheet is shown in Table 1.

The data of faucets includes brand, model, location (kitchen, basin, bath), appearance (round, square), material (stainless steel, bronze, ceramic, lead-free, zinc alloy), year of use (within 5 years, 5-10 years , more than 10 years), diameter (round faucet)/short side (square faucet) and corresponding mixing-cartridge specifications (diameter and high and low feet), etc. Through the simulation analysis of the decision tree and the expert system, a diagnosis system for the faucet mixing-cartridge is constructed (the system architecture is shown in Figure 1).

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3. DISCUSSION OF DIAGNOSIS SYSTEM AND CONCLUSION

When people want to DIY repair faucets to solve problems of faucets such as water leakage, dripping, and unstable water volume, these problems are mostly caused by problems with the mixing-cartridge. Information such as brand, place of use, appearance, material, year of use, diameter or short side length, etc., can be used to predict the type and specification of the mixing-cartridge to be used through system evaluation. According to the usage situation, it is roughly divided into two situations: knowing the brand but not knowing the model, and not knowing the brand. The decision-making mechanism of the diagnosis system according to different situations is explained as follows.

(1) Know the brand but don't know the type of faucet

The decision tree classification framework developed by the diagnostic system has a total of 15 categories according to the brand and location of use. For faucets that have been used for less than 10 years, the overall judgment accuracy rate is over 95-98%. Examples are as follows:

A: If you confirm that the brand is B brand and the place of use is the kitchen, then provide the body shape and body diameter or short side length. The decision tree classification structure is shown in Figure 2.

B: If it is confirmed that the brand is H brand and the place of use is the bathroom, then provide the body shape and body diameter or length of the short side. The decision tree classification structure is shown in Figure 3.

(2) Unknown the brand but don't know the type of faucet

If the people does not know the brand of the faucet at home, they can provide information such as the location of use, body shape, body diameter or short side length, material, and year of use. Through the mixing-cartridge specification prediction model developed by this research institute, it can provide information related to the appearance. After information, determine the type and specification of the mixing-cartridge used. The judgment model example is shown in Figure 4. There are 10 judgment models developed in this study, and judgments are made according to the types of data provided by users. As shown in Figure 4, the faucet of the bathroom basin, the appearance body is round, and the diameter of the body is 44-46mm, then the ceramic mixing-cartridge with 35 low feet is used; if the diameter is greater than 46mm, the ceramic valve core with 40 low feet is used. If the shape of the body is square, and the length of the short side of the body is between 43-45mm, a 35-foot ceramic mixing-cartridge is used. Overall, this type of judgment model has an average accuracy rate of about 85-90% after simulation analysis.

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Table 1 data of faucets

Faucet							mixing-cartridg	
Brand	type	place	figure	material	years	Diameter	Height	High /
HCG	KF6233	kitchen	cylinder	Lead-free	0-5	50.57	40	Low
HCG	KF580R	kitchen	cylinder	Cooper	0-5		40	Low
HCG	KF3779E	kitchen	cylinder	Cooper	0-5	39.65	31.5	Low
HCG	KF4139	kitchen	cylinder	Stainless	0-5	46.2	35	Low
HCG	KF3072	kitchen	cylinder	Cooper	0-5		40	Low

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HCG	KF6228	kitchen	cylinder	Cooper	0-5	50.7	40	low

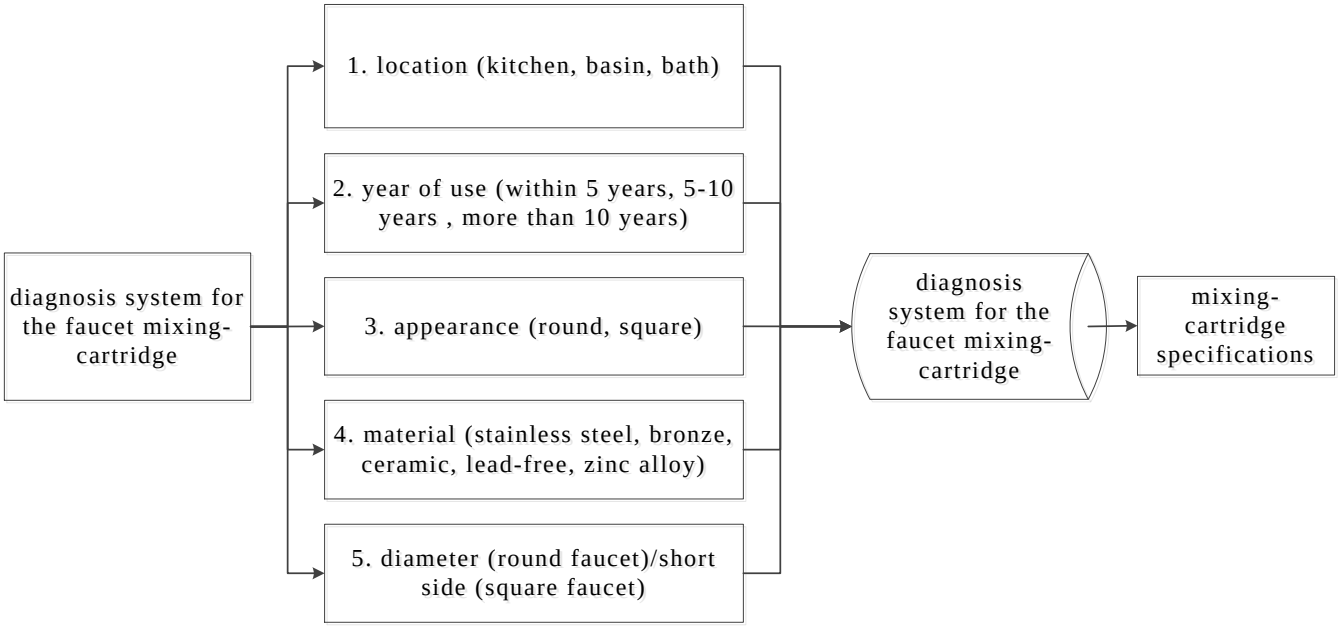

Figure 1 diagnosis system for the faucet mixing-cartridge

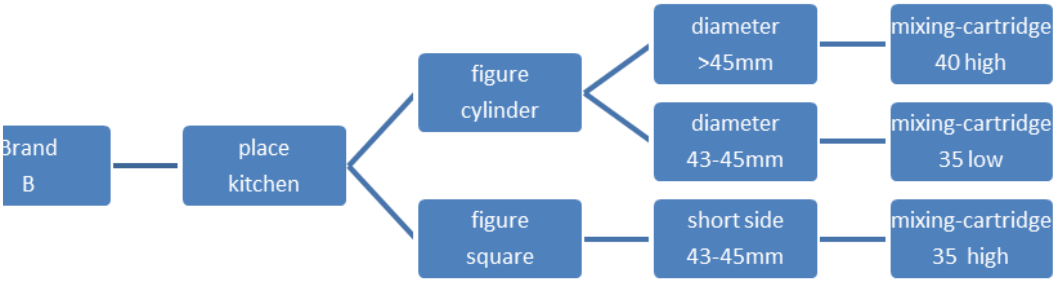

Figure 2 example 1 of the diagnosis system for the faucet mixing-cartridge

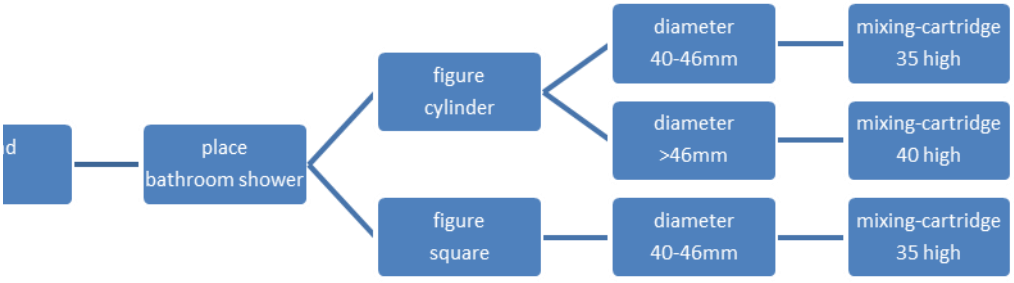

Figure 3 example 2 of the diagnosis system for the faucet mixing-cartridge

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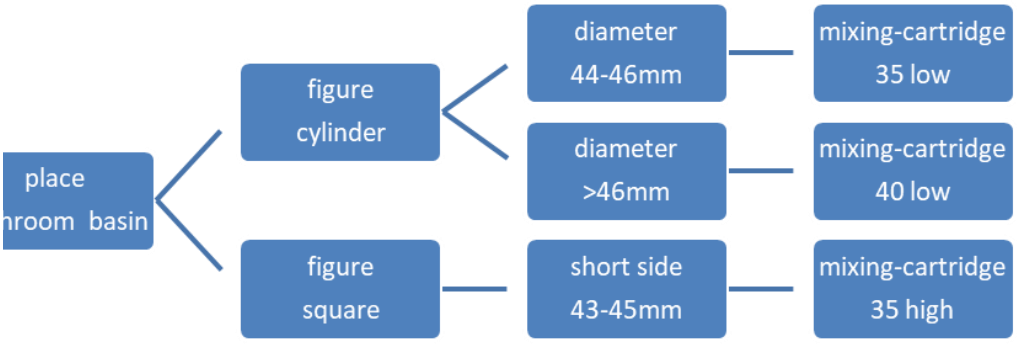

Figure 4 example 3 of the diagnosis system for the faucet mixing-cartridge