

System Design for Image Inspection of Residues in Agitator Drum of Ready-mixed Concrete Mixer Vehicle

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Abstract. This study carried out the concept development and the system-level design for the image inspection system of cleaning residues in agitator drum of ready-mixed concrete (RMC) truck. The design requirements of image inspection system were derived from the hardware properties of RMC truck and the conditions of RMC factory in the stage of concept development, and then 6 major components of image inspection system were selected by analyzing the design requirements in the stage of system level design. It seems that image inspection system could serve as an alternative to the visual inspection, leading to improve the quality management system for ready-mixed concrete.

Keywords: Ready-mixed concrete truck, Cleaning residues, Image inspection, System design

1 Introduction

Ready-mixed concrete (RMC) is a concrete which is produced in a batching plant of RMC factory and then delivered to a construction site by RMC trucks [1]. The interior and exterior of RMC truck need to be cleaned by spraying water in order to prevent hardening of the concrete waste on the RMC truck, and then the cleaning residues such as concrete waste and washing water should be removed from the agitator drum of RMC truck. Also, the RMC manufacturer should check the condition in agitator drum by visual inspection before loading the fresh-RMC into the truck. However, the visual inspection could not identify the residues easily because the interior of agitator drum is deep and dark. Thus, visual inspection of residues is time consuming and delays the loading of fresh RMC into the truck. This study was carried out in an attempt to develop an image inspection system of residues in agitator drum of RMC truck that could serve as an alternative to the visual inspection and to improve the quality management system for RMC.

2 Research scope and process

The system for image inspection of residues in agitator drum was developed in accordance with the procedure for product development proposed by Ulrich [3], which is composed of five major processes: concept development, system-level design, detailed design, integration and improvement, and release. Among the five processes, the scope of this study was concept development and system-level design of the image inspection system of residues in agitator drum as shown in Fig. 1.

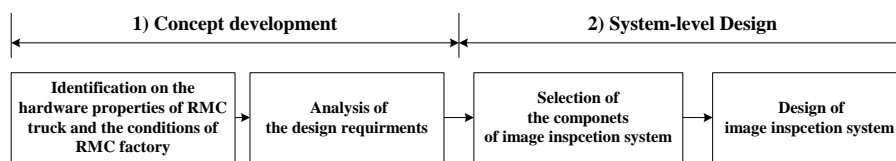


Fig. 1. Research scope and process

3 System design

3.1 concept development

In the stage of concept development, the design requirements of image inspection system were derived from the hardware properties of RMC truck and the conditions of RMC factory. Fig. 2 shows the shape of RMC truck and cleaning residues in the agitator drum, and Fig. 3 shows the RMC factory. The major design requirements of image inspection system, which were derived from Fig. 2 and Fig. 3, are shown in Fig. 4.

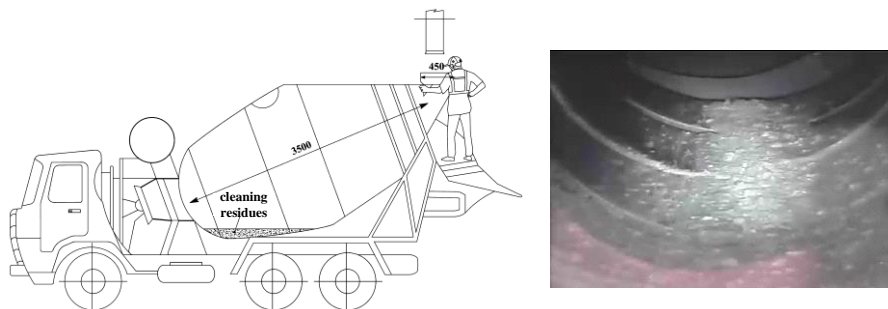


Fig. 2. The shape of RMC truck and cleaning residues in the agitator drum



Fig. 3. The RMC factory

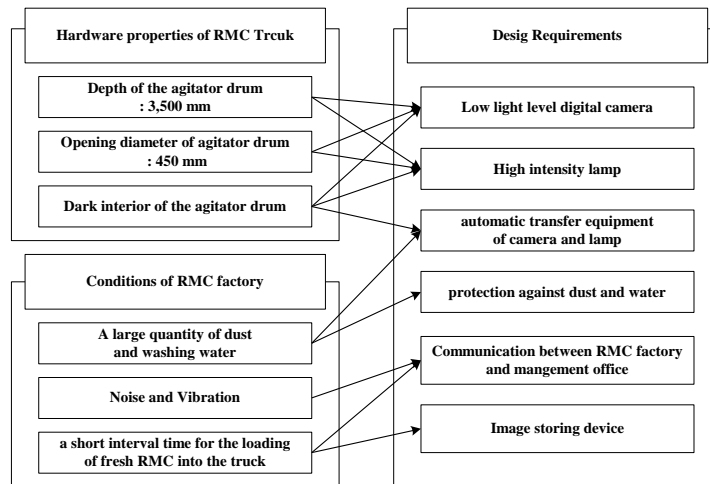


Fig. 4. The major design requirements of image inspection system

3.2 System-level design

In the stage of system level design, the components of image inspection system were selected by analyzing the design requirements. The image inspection system in our study consists of image inspection device, main system, controller, monitor, image storing device, and communication device as show in Fig. 5.

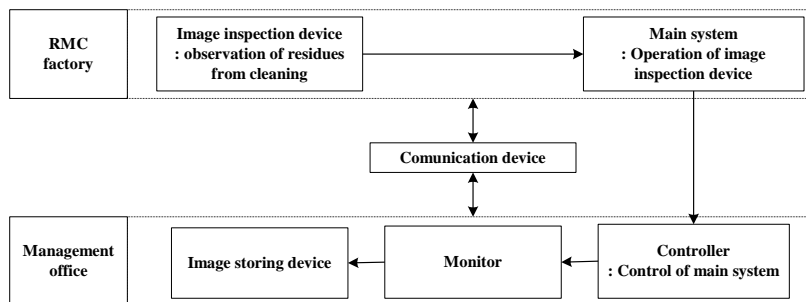


Fig. 5. Diagram of image inspection system

In addition, Fig. 6 shows shape of image inspection device which is the most important component of the image inspection system. In detail, image inspection device consists of low light level digital camera and high intensity lamp which are used for observation of residues from cleaning; automatic transfer equipment; square tube and cover used to protect camera and lamp from other materials such as dust and washing water.

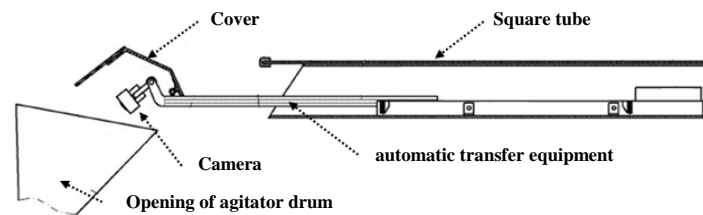


Fig. 6. The sharp of image inspection device

4 Conclusion

This paper reported the development of image inspection system of residues in agitator drum of RMC truck that could serve as an alternative to the visual inspection. Based on the results of concept development and system-level design, the following conclusions are made:

- 1) The major design requirements of image inspection system were derived from hardware properties of RMC truck and conditions of RMC factory.
- 2) The image inspection system consists of 6 components: image inspection device, main system, controller, monitor, image storing device, and communication device which were selected by analyzing the design requirements.
- 3) The image inspection device consists of low light level digital camera, high intensity lamp, automatic transfer equipment, square tube and cover.
- 4) Detailed design, integration and improvement, and release for the image inspection system are planned for future work by the authors.

References

1. ASTM Designation C 94-00.: Standard specification for Ready-mixed Concrete, Annual Book of ASTM standards, (2000)
2. Mehta, P.K, Monteiro, P.J.M.: Concrete: Microstructure, Properties and Materials, McGraw-Hill(1999)
3. Ulrich, K.T., Eppinger, S.D., Product design and development, McGraw-Hill(1999)