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Implementation of Embedded Control System for Flexible Movement of Intraoperative CT

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***Abstract*— Recently, the Intraoperative Computed Tomography (iCT) system is very useful in operating room because it can improve the surgical accuracy, reduce complications, and greatly improve patient treatment results. In addition, it is providing real-time 3D information and navigation, roadmap, and tracking functions in conjunction. The purpose of this study is to develop an integrated embedded controller of mobile iCT that provides easy movement and fast CT scan in hospital.**

I. INTRODUCTION

Mobile iCT may be useful when patient movement needs to be restricted such as a new coronavirus infection and critical patients [1,2]. However, the use of Mobile iCT is limited due to the narrow movement between hospitals. Therefore, in order to develop a useful mobile iCT in a narrow space, a mobile iCT using a mecanum wheel was developed in this study. In this study, we also developed an integrated embedded controller that provides fast CT scan to enable clinicians to make faster and more accurate diagnosis and treatment decisions for emergency patients.

II. METHODS

The integrated embedded controller of the iCT system is responsible for four main functions. First, it allows users to control iCT mobile movement and CT scan through RS422 communication with various embedded controllers. Second, the remaining battery power and state of charge used to move iCT are indicated by LED bar indicators. Third, images of the front camera and alarms of the ultrasonic sensor are displayed on the front monitor when the user moves the iCT. Fourth, it is responsible for marking the area of the patient table by the laser indicator and controlling the rotation gantry to the patient position. Figure 1 shows the block diagram of the integrated embedded controller.

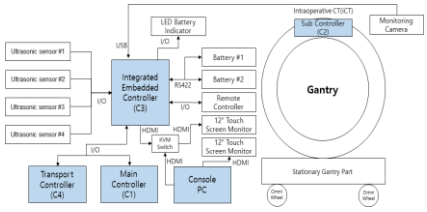

Figure 1. iCT System block diagram of embedded controller

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It is responsible for communication and control functions with multiple devices via USB, RS-422, and I/O interfaces. The integrated embedded controller was applied as a built-in design board that integrates 5V power supply circuit, GPIO photocoupler isolation circuit, and USB to RS-422 communication module using Raspberry Pi (Raspberry Pi 3B+, Raspberry Pi Foundation, United Kingdom).

III. RESULTS

In this study, we developed an integrated embedded controller for easily moving and fast CT scanning in mobile iCT. As shown in Figure 2, the integrated embedded controller used RS422, USB, GPIO interface for communicating with other embedded controllers. And the integrated embedded controller had functions that provides battery charge level with LED bar indicator, communication with transport controller and main controller according to user input from remote controller, displaying video from front monitoring camera, etc. The developed iCT system has improved image quality (with SNR = 109.78, CNR = 88.60 and MTF = 714 μm).

Figure 2. mobile iCT, monitoring view using front camea and CT images

IV. CONCLUSION

The integrated embedded controller for mobile iCT provides easy movement and fast CT scan functions which will be helpful in emergency patient treatment.

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