The Fourteenth International Symposium on Artificial Life and Robotics 2009 (AROB 14th '09),
B-Con Plaza, Beppu, Oita, Japan, February 5 - 7, 2009

Design and Implementation of Human Machine Interface Surveillance Systems for Tracked Robots

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Abstract: A tracked robot with one five-axle robotic arm is implemented in this paper. The key feature is the application of a LabVIEW platform applied to design a human machine interface (HMI) so that the robot can be guided by ZigBee based remote control. Moreover, VHDL and 8051 microprocessor will be used to design the controller and decode ASCII code, respectively, such that the remote monitoring and control system (RMCS) can be constructed successfully. The experimental results validate the practicality of LabVIEW platform applied for tracked robots.

Keywords: LabVIEW Platform, ZigBee, Human Machine Interface Surveillance Systems, Tracked Robots, Five-Axle Robotic Arm.

I. INTRODUCTION

Nowadays, the human machine interface surveillance systems have been successfully used for robotic development. For example, toward a generic human machine interface for assistive robots: the AMOR project [1], development of human-machine interface in disaster-purposed search robot systems that serve as surrogates for human [2], and bi-directional human machine interface via direct neural connection [3] etc., deal with positioning problems via human machine interface surveillance systems. However, as regards HMI-guided control, few researchers use LabVIEW platform to delve into tracked robots. In 2001, Priya Olden et al. presented an open-loop motor speed control with LabVIEW [4]. In 2006, Prasanna Ballal et al. proposed a LabVIEW based test-bed with off-the-shelf components for research in mobile sensor networks [5].

In this paper, we first implement a tracked robot with one five-axle robotic arm. Second, a LabVIEW platform will be applied to design a HMI so that any vehicle can be guided by ZigBee based remote control. In addition, VHDL and 8051 microprocessor are used to design the controller and decode ASCII code, respectively, such that the RMCS can be constructed successfully. Finally, to illustrate the effectiveness of the HMI surveillance system, the implemented tracked robot will be a test setup.

The experimental results validate the practicality of LabVIEW platform applied for tracked robots.

II. TRACKED ROBOTS

2.1 Disposition of The Self-Made Tracked Robot

Fig. 1 shows the self-made tracked robot. The apparatus consists of a stationary camera, placed in front of the vehicle, one five-axle robotic arm, placed beside of the camera, and a solar energy supply board, placed at the back of the vehicle. The solar energy supply board is designed to partly power the system by collecting energy from the solar panel.

The mobile vehicle is about 98 cm × 64 cm × 31 cm dimension. In this paper, the worth mentioning is that all devices are self-made except the camera and the solar energy supply board.

Fig. 1. Actual picture of the tracked robot

2.2 Five-Axle Robotic Arm

The actual picture of the self-made five-axle robotic arm is shown in Fig. 2. The robot consists of two middle-sized RC servo motors and five small-sized ones. The stretched arm is nearly 64 cm and the load is about 150-200 kgw.

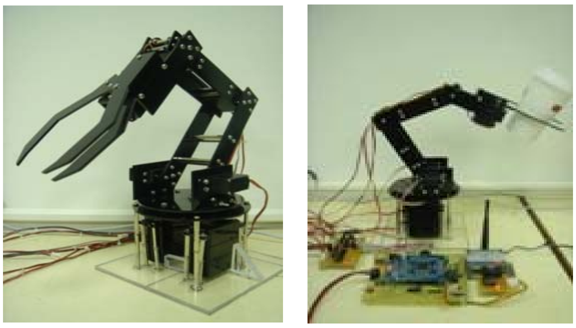

Fig. 2. Self-made five-axle robotic arm

III. IMAGE DETECTION

The procedures for the image transmission and the schematic diagram of the image transmission are shown in Fig. 3 and Fig. 4, respectively. The system consists of an image receiver, a TMS320DM642-PCI board, a wireless camera, and a servo motor (see Fig. 5-Fig. 7).

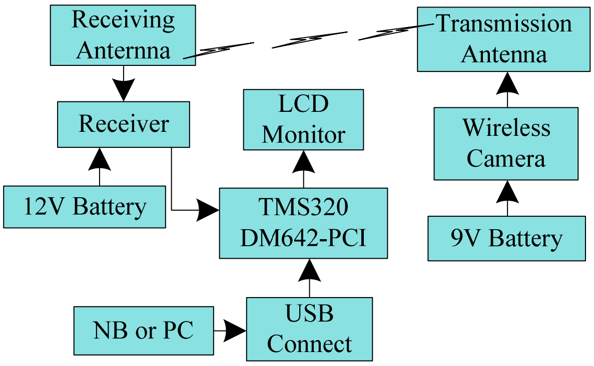

Fig. 3. Procedures for the image transmission

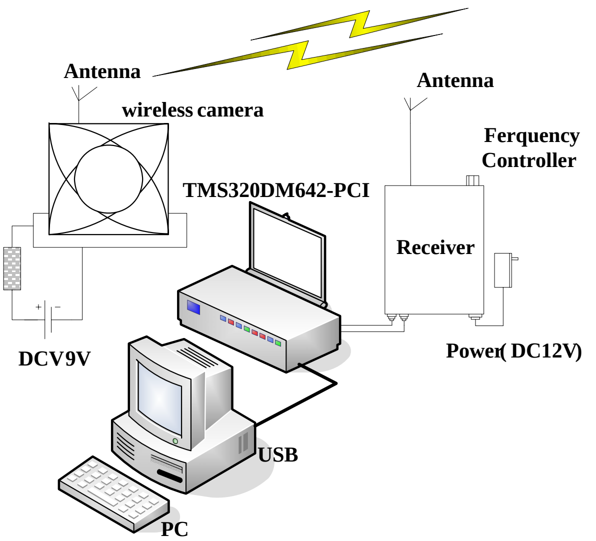

Fig. 4. Schematic diagram of the image transmission

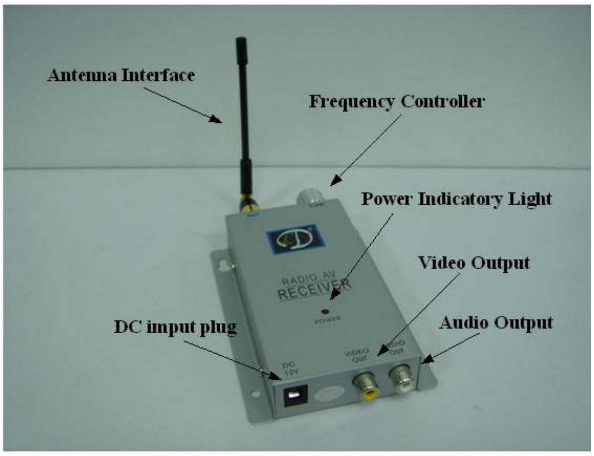

Fig. 5. Image receiver

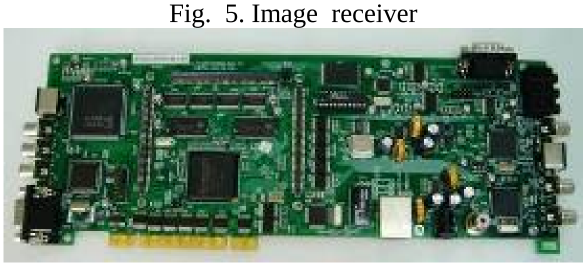

Fig. 6. TMS320DM642-PCI board

Fig. 7. Wireless camera and servo motor

IV. DESIGN OF HUMAN MACHINE INTERFACE SURVEILLANCE SYSTEMS

In this paper, we use LabVIEW graphical programming to design a human machine interface surveillance system. From the transmission of RS-232 and ZigBee modules, the command will be delivered to the controller, placed on the tracked robot so that the vehicle will be arrive at assigned place. Fig. 8 shows The LabVIEW block diagram. The LabVIEW front panel is shown in Fig. 9, where contains four parts. Block 1 can set the buad rate and I/O pins. Block 2 displays the pressed key. Block 3 is the panel for transforming strings into ASCII codes. Block 4 is the urgent stop button.

As regards ZigBee, it is established by IEEE 802.15.4 and ZigBee alliance. The ZigBee structure consists of PHY, MAC, network, security, API, and application. By the requirement, the ZigBee module can be a transmitter or a receiver. In this paper, the ZigBee module is used to deliver the data (see Fig. 11).

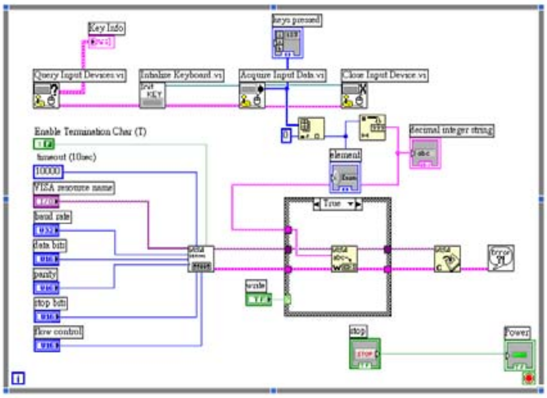

Fig. 8. LabVIEW block diagram

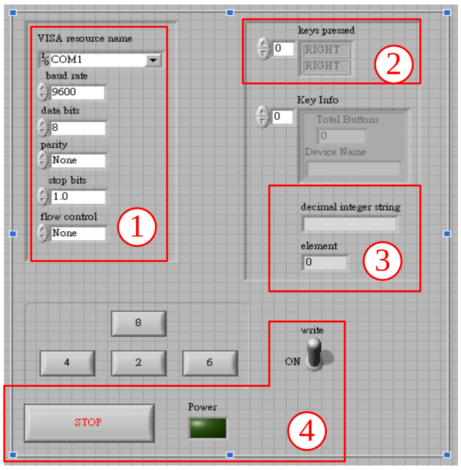

Fig. 9. LabVIEW front panel

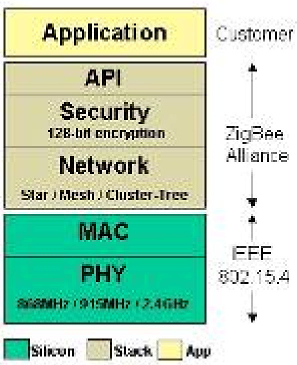

Fig. 10. ZigBee Structure diagram

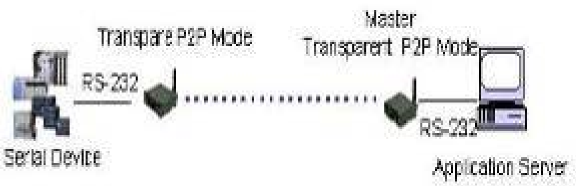

Fig. 11. Transparent P2P mode

V. EXPERIMENTAL RESULTS

The system structure block diagram is shown in Fig. 12. The supervisor can monitor the situation nearby the tracked robot via image-surveillance system, so that so that the robot can be guided by ZigBee based remote control. Fig. 13 shows the actual responses. The experimental results validate the practicality of LabVIEW platform applied for tracked robots.

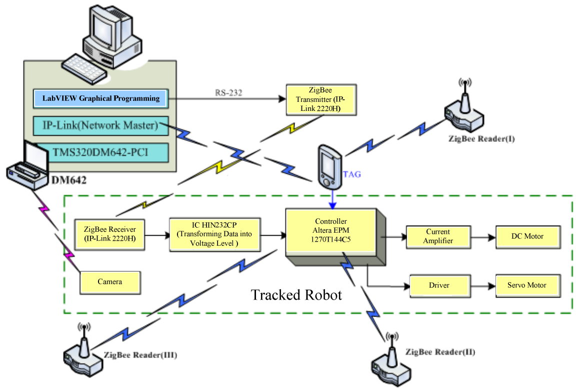

Fig. 12. The system structure block diagram

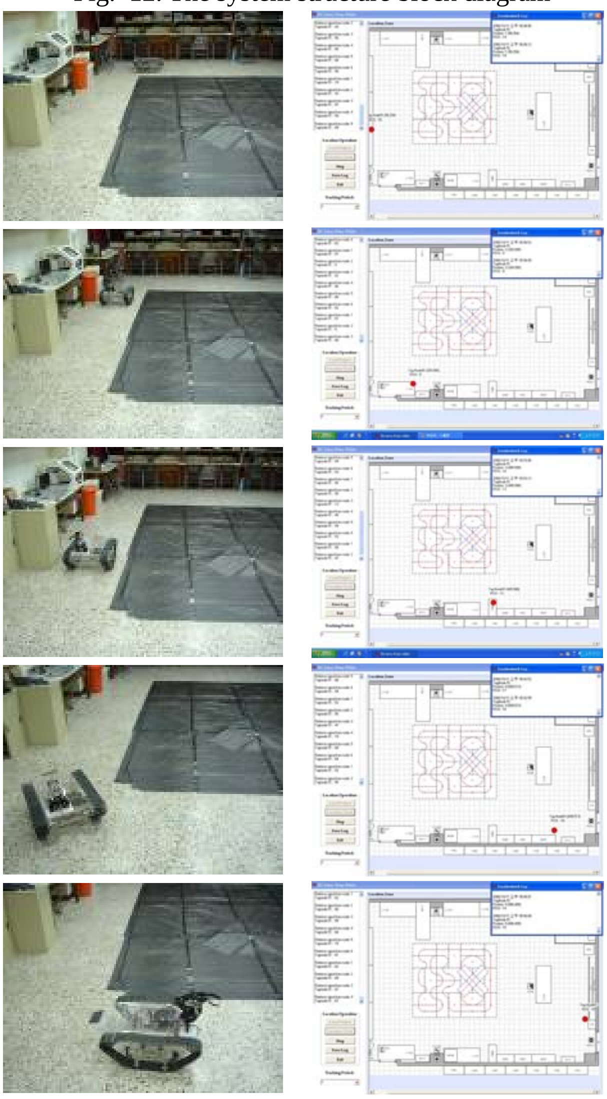

Fig. 13. Actual responses

VI. CONCLUSION

In this paper, a tracked robot with one five axle robotic arm is implemented. The key feature is the application of a LabVIEW platform applied to design a HMI so that the robot can be guided by ZigBee based remote control. Furthermore, VHDL and 8051 microprocessor will be used to design the controller and decode ASCII code, respectively, such that the RMCS can be constructed successfully. The experimental results validate the practicality of LabVIEW platform applied for tracked robots.

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