Information on Doctoral thesis of Fellows Tran Thuan Hoang

1. Full name: Tran Thuan Hoang

2. Sex: Male

3. Date of birth:17-04-1970

4. Place of birth: Quang Binh

5. Admission decision number: 3205/QĐ-SĐH, Dated 08/11/2011 of President of the Vietnam National University, Hanoi.

6. Changes in academic process: No

7. Official thesis title: Research on Sensor Fusion using for the Mobile-robot's Navigation

8. Major: Electronic Engineering

9. Code: 62 52 70 01

10. Supervisors: 1- Associate Professor Dr. Tran Quang Vinh

2 - Associate Professor Dr. Bach Gia Duong

11. Summary of the new findings of the thesis: Summary of the new findings of the thesis: This thesis proposed new algorithms of sensor fusion using the extended Kalman filter. Based on this, the localization, mapping, path planning, obstacle avoidance and motion control problems are addressed and improved.

The main contributions of this study are as follows:

- Design and develop a real mobile robot namely Multi-sensor smart robot in which a 3D laser range finder was developed from the 2D one. The robot system was tested and evaluated to ensure the functioning operation.

- Experimentally success in fusing up to 4 modern sensors (optical encoder, compass sensor, laser range finder and omni-directional camera). This result is obtained based on the use of the extended Kalman filter to enhance the accuracy of the localization.

- Propose a sensor fusion method called IPaDB which allows to build a 2D map of the environment containing rich 3D information.

- Propose an algorithm to improve the efficiency of the motion control by splitting this process into two configurations with two Lyapunov functions combined with the extended Kalman filter.

- Based on the combination of less ultrasonic sensors than ordinary, we have successfully implemented an improved algorithm of the VFH algorithm in order to deal with the local minimum problem so that the robot can safely reach the target.

12. Practical applicability: This contribution can be applied in practical applications in industry, health, education, and transportation

13. Further research directions: Research results will be extended to study the autonomous-guided-vehicles' navigation moving on the outdoor terrain.

14. Thesis-related publications:

1. T. T. Hoang, D. A. Viet, T. Q. Vinh (2011), "A 3D image capture system using a laser range finder", *IEICE Proceeding of the 2th international conference on Integrated Circuit Design*, pp.76-81.

2. Tran Thuan Hoang, Đang Anh Viet và Tran Quang Vinh (2011), "3D laser range finder used for autonomous mobile robot", i*n Vietnam on Control and Automation (VCCA-2011)*, pp. 257-260.

3. Hoang T. T., Duong P. M., Van N. T. T., Viet D. A. and Vinh T. Q. (2012) " Development of a Multi-Sensor Perceptual System for Mobile Robot and EKF-based Localization", *IEEE Proc. Conf. on Systems and Informatics*, pp. 519-522.

4. Hoang T. T., Viet D. A., Van N. T. T., Tuan P. D. and Vinh T. Q. (2012), "Extended Kalman Filter in Mobile Robot and FPGA-based Implementation", *IEICE Proc. of the 3th Int. Conf. on Integrated Circuit Design*, pp. 167-172.

5. Tran Thuan Hoang, Phung Manh Duong, Dang Anh Viet and Tran Quang Vinh (2012), "Multi-sensor mobile robot and the sensor fusion-based localization with Extended Kalman Filter", *The 2012 in ternational conference on advanced technologies for communications*, ATC/REV, pp. 130 – 135.

6. Tran Hiep Dinh, Manh Duong Phung, Thuan Hoang Tran, Quang Vinh Tran (2012), "Localization of a Unicycle-like Mobile Robot Using LRF and Omni-directional Camera", *Proceedings 2012 IEEE International Conference on Control System*, Computing and Engineering, pp. 477-482.

7. T. T. Hoang, P. M. Duong, N. T. T. Van, D. A. Viet and T. Q. Vinh (2012), "Multi-Sensor Perceptual System for Mobile Robot and Sensor Fusion-based Localization", *IEEE International Conference on Control, Automation and Informatics Sciences*, pp. 259-264.

8. T. T. Hoang, P.M Duong, N.T.T.Van, D.A.Viet and T.Q. Vinh (2012), "Development of an EKF-based Localization Algorithm Using Compass Sensor and LRF", *The 12th International Conference on Control, Automation, Robotics & Vision*, pp. 341-346.

9. Tran Thuan Hoang, Phung Manh Duong, Dang Anh Viet and Tran Quang Vinh (2012), "Navigation and obstacle avoidance for mobile robot using the 3D-laser image and ultrasonic signal", *The 6th Vietnam Conference on Machatronics*, pp. 451-458.

10. Thuan Hoang Tran, Manh Duong Phung, Thi Thanh Van Nguyen, Quang Vinh Tran (2012), *Stabilization Control of the Differential Mobile Robot Using Lyapunov Function And Extended Kalaman Filter*, Vietnam Journal of Sciences and Technology, 50(4), pp. 441-452.

11. T. T. Hoang, D. T. Hiep, P. M. Duong, N. T. T. Van, B. G. Duong and T. Q. Vinh (2013), “Proposal of Algorithms for Navigation and Obstacles Avoidance of autonomous Mobile Robot”, *8th IEEE Conference on Industrial Electronics & Applications*, pp.1308-1313.