

## INFORMATION ON DOCTORAL THESIS

1. Full name: Pham Van Thanh ..... 2. Sex: Male.....

3. Date of birth: 12/9/1990..... 4. Place of birth: Thai Binh .....

5. Admission decision number: 778/QĐ-CTSV Dated 21/8/2017 .....

6. Changes in academic process: No .....

*(List the forms of change and corresponding times)*

7. Official thesis title: Development of real-time systems to detect and track on-duty injured firefighters using advanced signal processing techniques.....

8. Major: Electronic Engineering..... 9. Code: 9 52 02 03.01 .....

10. Supervisors: Assoc. Prof. Tran Duc Tan .....

*(Full name, academic title and degree)*

11. Summary of the **new findings** of the thesis:

Firstly, the fusion of data from three-axis accelerometer, three-axis gyroscope, three-axis magnetometer, barometer and MQ7 sensor has been proposed to detect fall and loss of physical performance (to distinguish between loss of physical performance and the use of elevator) in firefighters; measure and alert the high CO level to optimize the service duration of self-contained breathing apparatuses (SCBA); count the number of steps, estimate step length, turning time and turning direction based on both private and public datasets (Publications No. 1, 2, 4, 6 and 7).

Secondly, we proposed to develop a highly accurate step counting method characterized by using four features: Minimal peak distance, minimal peak prominence, dynamic thresholding, and vibration elimination, and these features are adaptive with the user's states. Notably, minimal peak prominence is a powerful technique used to remove the false peak by measuring the intrinsic height of the current peak, together with other peaks by using a horizontal line from the current peak. The horizontal line will extend both to the left and right of the peak until it satisfies either of the following conditions:

- + Crossing the higher peak
- + Reaching the left or right of the signal or a window

Furthermore, the proposed features were combined with periodicity and similarity features to solve the problem of false walking. (Publications No. 3 and 5).

12. Practical applicability, if any:

The study on firefighter activity classification, injury detection, firefighter tracking and locating under indoor fire conditions yielded new findings of significance and highly practical applications to protect the on-duty firefighters' lives. In addition, these findings help shorten the time for inside victim search which contributes to ensure national security, social order and safety in the new situation.

13. Further research directions, if any:

For the future study, we will integrate more toxic gas sensors in our proposed system to detect aldehyde, fine particles, CO<sub>2</sub>, and HCN to give a more precise decision on whether to use SCBA. Besides, we will consider to integrate heart pulse sensors for heart rate measurement in order to better monitor and predict fall events. Furthermore, we will expand our study direction to detect steps and estimate step length in crawling state to support indoor positioning systems in predicting the positions of on-duty firefighters. Finally, we will develop software applications which can be embedded in IOs, android, window operating systems to support the commander in monitoring the firefighting and rescue performance as well as supporting on-duty injured firefighters.

14. Thesis-related publications: .....

*(List them in chronological order)*

1. **Pham Van Thanh**, Tuan Khai Nguyen, Duc Anh Nguyen, Nhu Dinh Dang, Huu Tue Huynh, Duc-Tan Tran\* (2021), "*Adaptive Step Length Estimation Support Indoor Positioning System using Low-Cost Inertial Measurement Units*", **2020 IEEE Eighth International Conference on Communications and Electronics**, 13-15 Jan. 2021, pp. 271-275.

2. **Van Thanh Pham**, Quang Bon Le, Duc Anh Nguyen, Nhu Dinh Dang, Huu Tue Huynh and Duc Tan Tran (2019), "*Multi-Sensor Data Fusion in A Real-Time Support System for On-Duty Firefighters*", **Sensors**, 19(21): 4746.

3. **Van Thanh Pham**, Duc-Tan Tran, Dinh-Chinh Nguyen, Nguyen Duc Anh, Dang Nhu Dinh, S. El-Rabaie and Kumbesan Sandrasegaran (2019), "*Development of a Real-time, Simple and High-Accurate Fall Detection System for Elderly Using 3-DOF Accelerometers*", **Arab J Sci Eng** **44**, 3329–3342 (2019).

4. **Van Thanh Pham**, Duc Anh Nguyen, Nhu Dinh Dang, Hong Hai Pham, Van An Tran, Kumbesan Sandrasegaran and Duc-Tan Tran (2018), "*Highly Accurate Step Counting at Various Walking Speeds Using Low-Cost Inertial Measurement Unit Support Indoor Positioning System*", **Sensors**, 18(10):3186.

5. Nguyen Van Duong, **Pham Van Thanh**, Tran Van An, Nguyen Tuan Khai, Duong Thi Thuy Hang, Hoang The Hop and Tran Duc Tan (2018), "*Elevator Motion States Recognition Using Barometer Support Indoor Positioning System*", **The 7<sup>th</sup>**

*International Conference in Vietnam on the Development of Biomedical Engineering*, pp.581-587.

6. The Hop Hoang, **Văn Thành Phạm**, Thúy Quỳnh Trần Thị, Hữu An Nguyễn, Tuan Khai Nguyen and Tan Tran-Duc (2018), “*Xây dựng hệ thống xác định độ cao bên trong nhà và công trình sử dụng đa cảm biến áp suất*”. *Hội nghị Quốc gia lần thứ XXI về Điện tử, Truyền thông và Công nghệ Thông tin (The 21<sup>st</sup> National Conference on Electronics, Communications and Information Technology)*, pp.196-200.

7. **Pham Van Thanh**, Anh-Dao Nguyen Thi, Quynh Tran Thi Thuy, Dung Chu Thi Phuong, Viet Ho Mau and Duc-Tan Tran (2017), “*A Novel Step Counter Supporting For Indoor Positioning Based On Inertial Measurement Unit*”, *7<sup>th</sup> international conference on Integrated Circuit, Design, and Verification (ICDV)*, pp. 69-74.

Date: .....

Signature: .....

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Date: .....

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Full name: .....

*Note: “Information on Doctoral Thesis” must be processed on Microsoft Word, font Unicode Times New Roman, letter size 13. “ Summary of the new findings of the thesis ” should be one-A4 page long.*