



# Intelligent Manufacturing & Mechatronics

Proceedings of Symposium, 29 January 2018, Pekan, Pahang, Malaysia

Editors: **Hassan**, Mohd Hasnun Arif (Ed.)

Mohd Hasnun Arif Hassan  
Editor

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 Springer

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# Preface

The Symposium on Intelligent Manufacturing and Mechatronics (SymposIMM) 2018 was held at Universiti Malaysia Pahang in Pekan, Pahang, Malaysia, on 29 January 2018. It was organized by the Faculty of Manufacturing Engineering, Universiti Malaysia Pahang (UMP), in collaboration with the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka (UTeM), Melaka. Both parties aimed to provide a platform for deliberating empirical and theoretical research that are foreseen in the context of Industry 4.0. With the theme of “Strengthening Innovations Towards Industry 4.0”, it is the first dedicated symposium to Industry 4.0 hosted by the organizers. The symposium was graced by a vivacious keynote speech entitled “The Ideas of Mechatronics” by Prof. Ir. Dr. Wan Azhar Wan Yusoff.

This symposium enticed 120 submissions from authors nationwide. All submissions underwent a strenuous peer review process from members of the Peer-Reviewing Technical Committee. The reviews were based on the manuscript’s relevance to the tracks, novelty of the findings, the importance and presentation of the studies towards the particularity of Industry 4.0’s current trends. Following the review process, only 65 submissions made it into the symposium, 15 submissions were withdrawn, and 40 submissions were rejected due to various reasons. The accepted submissions were divided into five tracks covering various scopes of manufacturing engineering and mechatronics stream, namely Intelligent Manufacturing, Robotics, Artificial Intelligence, Instrumentation, and Modelling and Simulation. This book was divided into five parts based on the aforementioned tracks.

We would like to express our gratitude to all members of the Organizing Committee, without which the organization of this symposium would never be possible. Special thank goes to the management of the Faculty of Manufacturing Engineering, Universiti Malaysia Pahang, for the support towards the successful organization of the symposium. Further, we would like to extend our thanks to all authors for their participation in the symposium and their valuable contribution to this book. Last but not least, we would like to appreciate the help from the

publisher, especially to Dr. Christoph Baumann and Mr. Arumugam Deivasigamani. We hope that the contents of this book will benefit the readers in embracing the new era of industrial revolution 4.0.

Pekan, Pahang, Malaysia  
January 2018

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# VEHICLE DETECTION SYSTEM USING TUNNEL MAGNETORESISTANCE SENSOR

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**Abstract.** Vehicle detectors are useful to provide essential information such as parking occupancy and traffic flow. To create one robust vehicle detector which works not only in controlled environment (*i.e.* indoor), but it should also work in outdoor environment, a vehicle detection using magnetic approach is proposed. The magnetic signal of a vehicle will be measured based on magnetic remanence technique where it will be processed to a cloud database. To achieve a low-cost and sensitive system, a Tunnel Magnetoresistance (TMR) sensor is employed. With the combinations of software filter and state machine's algorithm, the occupancy of the car park can be identified with high accuracy. After a few series of real field testing, it is shown that a vehicle in a parking lot can be detected by measuring the surrounding magnetic field that is disrupted by the presence of vehicles. The proposed system is tested for forward and reverse parking, and it shows a high accuracy detection for a B-segment sedan car. It can be expected that by using the proposed technique, detection of vehicles using a low-cost system with capability of online monitoring can be realized.

**Keywords:** Tunnel magnetoresistance, magnetic sensors, vehicle detectors.

## 1 Introduction

Intelligent transport [1], smart cities [2], [3] and Internet of Things [4] are terms that surround us all the time in this century. With growing population, mobility of people using vehicles will increase rapidly and this will result to severe issues such as parking problem of vehicles. Hence, intelligent and centralized solutions to lessen these problems are highly desired, where specifically in the case of vehicle parking problem, gathering and online monitoring data about traffic flow and absences of vehicle in a parking slot are important. Based on the real-time data, traffic congestion and the required time to find a vehicle parking slot can be mitigated by efficiently controlling the flow of vehicles.

In conventional ways of vehicle detection, ultra-sonic sensor is used to obtain the information of parking spot due to its low cost, easy installation, and high accuracy. The vehicle detection using the ultrasonic sensor works by emitting radio waves and detecting the reflected radio waves. This method works efficiently in a controlled environment such as inside indoor; however, it is sensitive to the fluctuations of tem-