

**INVESTIGATIVE STUDIES OF EMBEDDED  
ASSEMBLY LINE AUTOMATION SYSTEM WITH  
DUAL RFID PLATFORM**

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**INVESTIGATIVE STUDIES OF EMBEDDED ASSEMBLY LINE  
AUTOMATION SYSTEM WITH DUAL RFID PLATFORM**

**by**

**SAMIHAH BINTI ABDULLAH**

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## LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASCII	American Standard Code for Information Interchange
AT	Transparent
CC	Cloud Computing
DOE	Design of Experiments
EM	Electromagnetic
EN	End Node
EPC	Electronic Product Code
GEN 1	Generation 1
GEN 2	Generation 2
GUI	Graphical User Interface
HF	High Frequency
IEEE	Institute of Electrical and Electronics Engineers
IC	Integrated Circuit
ID	Identification
IoT	Internet of Things
ISM	Industrial, Scientific and Medical
ISO	International Organization for Standardization
ITU	International Telecommunication Union
LAN	Local Area Network
LED	Light Emitting Diode
LCD	Liquid Crystal Display
LF	Low Frequency
LOS	Line-of-Sight
M2M	Machine to machine
MCU	Microcontroller Unit

NLOS	Non-Line-of-Sight
PAN	Personal Area Network
PAR	Passive and Active RFID
PR	Passive RFID
PC	Personal Computer
PCB	Printed Circuit Board
PD	Percentage Detection
PL	Path Loss
PIC	Programmable Integrated Circuit
RF	Radio Frequency
RFID	Radio Frequency Identification
RSSI	Received Signal Strength Indicator
RTOS	Real-Time Operating System
SA	Spectrum Analyzer
SOC	System on Chip
TTF	Tag Talk First
TX	Transmitter
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-High Frequency
USA / US	United States of America
USB	Universal Serial Bus
UPC	Universal Product Code
UWB	Ultra-Wide Band
Wi-Fi	Wireless Fidelity
WM	Wireless Manufacturing
WMN	Wireless Mesh Network
WMSN	Wireless Mesh Sensor Network

WSN	Wireless Sensor Network
ZC	ZigBee Coordinator
ZED	ZigBee End Device
ZR	ZigBee Router

## **KAJIAN-KAJIAN PENYIASATAN BAGI SISTEM BARIS PERHIMPUNAN TERBENAM DENGAN DUA PLATFORM RFID**

### **ABSTRAK**

Kelemahan sistem inventori kawalan dan ketinggalan zaman telah meningkatkan kerumitan pengurusan barisan pengeluaran kilang, terutamanya oleh peningkatan jualan dan permintaan dalam industri. Sistem yang tidak terurus di dalam barisan pemasangan menyebabkan masalah ketidakcekapan dalam menjejaki kelantangan produk. Objektif penyelidikan ini adalah untuk membangunkan reka bentuk baru seni bina RFID yang dibenamkan (pasif dan sistem aktif) ke dalam satu sistem untuk mengesan dan memantau proses penghantaran produk di barisan pemasangan di industri. Gabungan baru RFID berasaskan 2.4 GHz ZigBee yang beroperasi di platform rangkaian sensor tanpa wayar dicadangkan sebagai penyelesaian kepada masalah pengurusan produk. Sementara itu, sistem yang dicadangkan melibatkan reka bentuk perkakasan dan perisian yang dibenamkan dengan pembaca RFID pasif di Ultra High Frequency (UHF). Keputusan dari eksperimen yang dijalankan menunjukkan bahawa sistem terbenam iaitu Passive and Active RFID (PAR) menghasilkan prestasi keseluruhan yang lebih baik berbanding sistem RFID (PR) pasif yang berdiri sendiri. Ujian jarak dalaman diukur dari jarak 0 hingga 60 m. Pengukuran yang diperolehi pada jarak 1 m dan 60 m dari rangkaian penghantaran adalah -33 dB dan -51 dB masing-masing. Ia juga diperhatikan bahawa sistem terbenam mempunyai nilai kekuatan isyarat yang lebih baik 7.84% berbanding sistem sendiri pada 60 m. Untuk tahap kuasa tertinggi, iaitu tahap 4 (10 dBm) didapati hanya 0.02 dB kehilangan isyarat dan berlaku 99.8% kepada nilai teori bagi sistem PAR. Nilai-nilai throughput untuk tertanam adalah antara 12 kbps hingga