Ain Shams University
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Wireless Sensor Networks for Environmental Monitoring

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A thesis submitted in conformity with the requirement for Degree of Doctor of Philosophy in Science (Physics - Electronics)

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بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

قُل لَّوْ كَانَ الْبَحْرُ مِدَادًا لِّكَلِمَاتِ رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ
أَن تَنفَدَ كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا ﴿١٠٩﴾
قُلْ إِنَّمَا أَنَا بَشَرٌ مِّثْلُكُمْ يُوحَىٰ إِلَيَّ أَنَّمَا إِلَٰهُكُمْ
إِلَٰهٌ وَاحِدٌ ۖ فَمَن كَانَ يَرْجُو لِقَاءَ رَبِّهِ فَلْيَعْمَلْ عَمَلًا
صَالِحًا وَلَا يُشْرِكْ بِعِبَادَةِ رَبِّهِ أَحَدًا ﴿١١٠﴾

[سورة الكهف]

Dedicated

To

My Professor

Dr. Aisha Mostafa Swidan

(رحمها الله)

Dedicated

To

My parents (Father and Mother),

My brothers & sister

My professors,

And
My friends

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List of Symbols and Abbreviations

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A.U	*Arbitrary Unit*
ACA	*Ant Colony Algorithm*
AWACS	*Airborne Warning and Control System*
CONSLUT	*Consultation Algorithm*
C_s	*Communication range*
DARPA	*Defense Research Advanced Projects Agency*
DSN	*Distributed Sensor Networks*
Eas	*Evolutionary Algorithms*
E_f	*Sensor efficiency*
Ei	*Dissipated energy*
E_s	*Residual energy*
F_{avg}	*Average fitness of current generation*
FL	*Fuzzy Logic*
FLCs	*Fuzzy Logic Controllers*
F_{max}	*Maximum fitness by current generation*
F_{min}	*Minimum fitness by current generation*
F_{ratio}	*Current fitness level of chromosomes*
GA	*Genetic Algorithm*
Homo-H-VFCPSO	*Homogeneous Hierarchical Virtual Force Directed Coevolutionary Particle Swarm Optimization*
I	*Radioactive intensity*
IPRL	*Intelligent Personal Radiation Locator*

K	*Link budget constant*
LEDR	*Leader Election Algorithm*
M. Intensity	*Robot Intensity*
MEMS	*Micro-Electro-Mechanical Systems*
MODA	*Multi-Objective Deployment Algorithm*
Mp	*Robot decision*
N_{CG}	*Current generation number*
NEMS	*Nanoscale Electro-Mechanical systems*
N_G	*Total number of generations*
N_{ratio}	*Optimization stage of GA*
N_s	*Sensing range*
P_C	*Crossover percentage*
P_a^t	*Probability of locating the sensor in cell a at time t*
PFDA	*Potential Field Deployment Algorithm*
P_M	*Mutation percentage*
RF	*Radio Frequency*
R_s	*Reliability*
SOSUS	*SOund SUrveillance System*
WSN	*Wireless Sensor Network.*
Y. Intensity	*Consulted robot intensity*
Yp	*Consulted robot decision*
ω_a	*Weight function*