Department of Architecture
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The Integration of Buildings' Energy Simulation Tools (ESTs) with Intelligent Decision Support Systems (IDSS)

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BSc in Building Engineering – Ain Shams University

A Thesis Presented in Partial Fulfillment of the Requirements for
Master of Science Degree in Architectural Engineering

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Statement

This thesis is submitted as partial fulfillment of M.Sc. degree in Architectural engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or qualification at any other scientific entity.

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Abstract

The use of Building Energy Simulation Tools (BESTs) is becoming widely common among building engineers and architects as the need for sustainable buildings keeps growing. The amount of challenges within the energy optimization process is also increasing as (BESTs) are developing to become more detailed. Major challenges such as uncertainty and sensitivity within the energy simulation process and the multivariate property within the energy optimization process are being widely discussed nowadays.

The power of today's computational methods within the field of Artificial Intelligence (AI), and today's proven application of AI branches, such as: expert systems, machine learning, and deep learning; this power, in fusion with the well-established science of Decision Support Systems (DSS), forms Intelligent Decision Support Systems (IDSS); which is expected by the researcher to provide BESTs with the needed intelligence and expertise to be able to solve the existing building's energy simulation challenges, and smoothing the BES process as well.

The multi-disciplinary parametric property of the optimization process, and the occurring variation in constraints along the design and construction phases do also require an energy simulation tool that is capable of co-oping like an expert with this change in different parameters all along the building process timeline; this tool must exist as an aiding tool to the building engineer from the moment the energy model is built, all through the construction phase, and until building operation, this tool must be also capable of producing justifications, and provide certainty and sensitivity assistance to the engineer, for providing more rigid energy related decisions during the model's lifecycle.

Therefore, the thesis aims to study the possible integration between the Buildings' Energy Simulation Tools (BESTs) with the Intelligent Decision Support Systems (IDSS), as an attempt to reach a theoretical framework of a buildable IDSS-aided BEST; BEST-IDSS.

Acronyms and Abbreviations

AHU	Air Handling Unit
AI	Artificial Intelligence
BAS	Building's Automation System
BCx	Building Commissioning
BDL	Building Design Language
BES	Building Energy Simulation
BEST	Building Energy Simulation Tool
BIM	Building Information Modelling
BMS	Building Management System
BPD	Building Performance Database
BPS	Building Performance Simulation
CAD	Computer Aided Design
CF	Certainty Factor
CHP	Combined Heat and Power
COP	Coefficient of Performance
Cx	Commissioning
DAI	Distributed Artificial Intelligence
DALI	Digital Accessible Lighting Interface
DM	Decision Making
DOE	Department Of Energy
DP	Differential Pressure
DSS	Decision Support System
EER	Energy Efficiency Ratio
EM	External Memory
EPA	Environmental Protection Agency
EST	Energy Simulation Tool
ETMY	Egyptian Typical Meteorological Year
IBPSA	International Building Performance Simulation Association
IDSS	Intelligent Decision Support System
IoE	Internet of Everything

IoT	Internet of Things
IPMVP	International Performance Measurement & Verification Protocol
IPS	Information Processing System
IWEC	International Weather for Energy Calculations
LAN	Local Area Network
LEED	Leadership in Energy and Environmental Design
LON	Local Operating Network
LPD	Lighting Power Density
LTM	Long Term Memory
M&V	Measurement and Verification
M2M	Machine to Machine
MCTS	Monte Carlo Tree Search
MEP	Mechanical, Electrical, and Plumbing
MIS	Management Information System
NREL	National Renewable Energy Laboratory
O&M	Operation and Maintenance
OLAP	Online Analytical Processing
OPR	Owner Project Requirements
SAGE	Semi-Automatic Ground Environment
SHGC	Solar Heat Gain Coefficient
STM	Short Term Memory
TAB	Testing, Adjusting, and Balancing
TR	Ton Refrigerant
U-value	Measure of thermal transmittance
UI	User Interface
VFD	Variable Frequency Drive
VT	Visible Transmittance

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