CHAPTER-2
LITERATURE REVIEW

The Chapter discusses the literature review which has been carried out for studying the existing technologies and finding the problem statement from the research gap. The various papers on already existing technologies used to control the linear and non-linear devices are referred from reputed journals. The need of current research presented in this thesis is also concluded from the literature survey.

2.1 Findings of Literature Review

The detailed discussion on the different papers is listed sequentially.

Ku, K.L. et al. presents a wireless sensor network based thermal comfort system. The system is designed to maintain the room temperature as per changing in surroundings, the results are achieved with neurofuzzy and PSO. The system utilizes feed forward – feedback control and self-tuning control and the simulation results shows 30% of energy saving using the proposed system [12].

Limitation: Paper only describes the thermal comfort system using neurofuzzy and PSO, but doesn't include other environmental parameters.

Mohammad Noshad et al. suggest a Transmission scheme is proposed to enhance the indoor optical wireless communication systems to avoid the limitation of Visible light communications (VLC) of limited bandwidth of LEDs and inter symbol interference due to multipath. In proposed system the dimming of the indoor illumination is done by using Expurgated pulse-position modulation (EPPM) with Interleaving [9].

Limitation: Paper concludes communication module other than IR communication and its limitations, but doesn't discuss RF communication mode.

Mohammad Esmaeilzade Shahri et. al discusses the possibility of a Fractional-Order Proportional-Integral-Derivative (FOPID) controller for time delay

systems. For improving the control efficiency of time delay, DE and Smith predictor control methods are combined [13].

Limitation: Paper shows the improvement in efficiency of PID controller with some optimizing algorithm, but it doesn't include PSO algorithm for comparison.

Zhen-ya Liu discusses the Zigbee and GSM based intelligent home environment monitoring system. System is designed to monitor the parameters like smoke, gas, fire, temperature and humidity [11].

Limitation: Paper discusses the environment parameters monitoring, but doesn't consider controlling system for the same.

Hadi Ramezanian et al. propose a method to tune PID controller using PSO for automatic voltage regulation. Paper also discusses the improvement in efficiency of the system by comparing the system with other existing techniques [6].

Limitation: Paper compares the existing techniques for controller tuning with PID using PSO, but only on simulation no hardware is developed.

Sunghoi Parka et al. propose a ZigBee based Smart Energy Management System (SEMS) which is controlled with the help of motion sensor. Settling time of power usage is managed to reduce power consumption [14].

Limitation: Paper proposes Zigbee module only to transmit the data wirelessly.

Pandharipande, A. et al. suggests a light sensor and motion sensor based system, for indoor lightning. The system is designed using chargeable photovoltaic cell, which charges with daylight. The whole system is controlled wirelessly. It employs a feedback control algorithm to determine the dimming levels of the luminaires. Proposed prototype allows a lifetime of 20h in a complete dark environment [15].

Limitation: Paper suggests dimming of lightning system only, doesn't include control of any other physical parameter of the building.

Yusoff, Y.M. et al. discusses an integrated wireless sensor network with wasp mote and meshlium gateway to save energy. The system proposes light intensity control by pulse width modulation. It would be helpful in developing Smart street lighting system for smart cities [16].

Limitation: Paper focuses only on wasp mote for smart street light for energy saving.

Kok-Hua Teng et al. proposes an android smart phone as remote control is to control dimming levels of LED. Control signal is generated with smart phone which is decoded by microcontroller to generate PWM signal to control brightness of LED. This system results in improved energy efficiency [17].

Limitation: Paper describes dimming system being controlled using android phone, which is licensed network and costs high.

Shun-Chung Wang et al. describes a dimming system for T5 fluorescent lamps. The diming is achieved with the help of EMI filter, an active power factor correction, inverter and dimming system power stage [18].

Limitation: A prototype is developed only for lightning system, the communication media has not been discussed.

Shaikh, A.N. et al. proposes an intelligent wireless system to monitor and control of street lights. Each light has a unique IPv6 address. The system is designed with an RF IC CC1180 and microcontroller MSP430F663. The ISM band is used for communication between nodes, between gateway and control center through GPRS. This system offers almost 50% power saving and reduces the patrol cost [19].

Limitation: Paper discusses the monitoring and control of street lights and concludes power saving by 50%. The system is designed only to control on/off system.

I.Khan et al. concludes that by implementing home energy management system, energy consumption can be handled more efficiently. Also home appliance coordination with different tariff schemes is a good solution, but it has various challenges in implementation [20].

Limitation: Paper only discusses the various home energy management schemes and challenges.

K. Latha et al. explains the process models for time delayed using tuning of PID controller with PSO [7].

Limitation: Paper focuses on simulation model for PID controller using PSO but no testing on real time hardware is done.

Andru, L. et al. describes Street lighting monitoring and control system by using JN5148 wireless module with dimming circuit. For vehicle detection two methods are proposed one using PIR sensor and another Doppler sensor, among which results of Doppler method are shown to be better [21].

Limitation: Paper only discussed street light control through dimming circuit with different sensors, but human comfort is not considered.

Jer-Vui Lee et al. discusses a smart elderly home monitoring system (SEHMS). System is designed with 3-axial accelerometer with Android-based smart phone application to monitor fall and heat attack [22].

Limitation: Paper includes smart monitoring system with android phone, but it doesn't conclude control part.

Stefan I. Et al. developed a wireless system for LED. The system performance is compared for two dimming techniques Pulse Width Modulation and Continuous Current Reduction. CCR is observed as more efficient technique. The system performance is assessed in the form of signal to noise ratio and bit error rate [23].

Limitation: In this paper dimming methods for LED are discussed but methods for other home appliances are not included.

Chunlong Zhang et al. describes the Internet of Things and ZigBee based wireless sensor network to monitor the environmental parameters like temperature, humidity, meter readings, light [24].

Limitation: Paper describes the monitoring of physical parameters of the building but doesn't discuss the control part.

Biao Sun et al. describes the new approach to reduce the energy consumption. For effective strategy a methodology is proposed by combining dynamic programming and roll out techniques [25].

Limitation: Paper suggests the method to reduce the energy consumption, but cost of system development is not considered.

Ibtissem Chiha et al. discusses the tuning of PID controller using ACO by defining the objective function. Comparative study of ACO with genetic algorithm and Ziegler Nichols methods are discussed and ACO is concluded as better option [26].

Limitation: Paper shows comparative study for ACO, GA and Ziegler Nichols methods only on simulation.

Qela, B et al. proposes a new approach for smart homes based on observe, learn and adapt algorithm with the combination of wireless sensor networks and artificial intelligence, for smart homes [27].

Limitation: The technique discussed in the paper is based on the observing patterns for change in parameters but doesn't consider users requirement and comfort.

Mikael Björkboma et al. discusses about simulation model for control system design with wireless network. For the simulation purpose PiccSIM simulator is used and results introduces relationship between the network type and control performance [28].

Limitation: This paper discusses the simulation models for control system design and evaluates performance of the system but doesn't consider the hardware complications.

David Keyson et al. describes the design of a smart home management toolkit system. It has three components- smart plug, gateway and a mobile application [29].

Limitation: Smart home management system is proposed with mobile application which is not a cost effective solution.

D. Ibrahim describes, the design of temperature control with various control strategies using microcontroller with the help of feedback control [30].

Limitation: A microcontroller based tool kit is designed only for temperature control, but other physical parameters required for human comfort are not considered.

Woong Hee Kim et al. proposes a wireless sensor network based energy management system. The system has two main components remote control and an intelligent home gateway for sensing and transmitting electricity data [31].

Limitation: Real time monitoring and controlling of home appliances are proposed, but only for ON/OFF of the appliances.

Wa Si et. al proposes particle swarm optimization based wireless sensor network for an energy saving, for office lightning by using fluorescent lamps with dimming capacity [32].

Limitation: Paper concludes PSO as power saving algorithm for lighting system but other comfort parameters are not considered.

S. Ravi et al. describes a temperature plastic extrusion system for controller design method, which improves couple effects, time constants, settling time, and undesirable overshoot [8].

Limitation: Paper includes simulation of GA based temperature control system, but no hardware implementation is discussed.

Qiaoling Tong et al. presents a solution for stability to nonlinear system. A simulation is designed for closed feed water heater to control the levels of system. It is done by dynamic response tests on set points in the presence of various disturbances [33].

Limitation: Only Simulation based results are evaluated for controlling the water heater.

Guilin Zheng et al. narrates, PSO is good to tackle the problems which are nonlinear, non-differentiating and multimode domain. PSO can be applied to WLAN to optimize the location, for indoor propagation problem [29].

Paper says, ACO algorithm is based on the behavior of ant for searching food. When an ant propagates on a path, from nest to the location of food, it emits pheromone. Sensing this pheromone the other ants can choose the same path to reach at destination. The path with the maximum pheromone concentration is considered as the shortest way to food [34].

Limitation: Paper describes ACO and PSO as optimizing algorithm only theoretically no actual implementation tricks are discussed.

Ching-Chang Wong et al. narrates, an automatic voltage regulator system with better control performance. Simulation based performance is analyzed for GA and PSO with PID [35].

Limitation: Paper evaluates simulation based performance of AVR system with comparative analysis of GA, PSO and PID, it doesn't offer same type of exercise with other systems or hybrid system.

Jinsoo Han proposes a Zigbee and IR code learning based control for home appliances. In order to reduce power consumption the room architecture is proposed with diming levels of light [36].

Limitation: Paper suggests Zigbee based remote control for light only, but doesn't offer hybrid remote control for multiple appliances.

A.I. Dounis et al. gives a review on the comfort conditions inside a building with the consideration of energy conservation. The simulation results are compared for existing techniques and concluded among selected techniques multi-agent control system shows better results in terms of comfort as well energy conservation [37].

Limitation: Paper compares only the simulation results for energy conservation in a building.

Xianghui Cao et al. discusses about the performance analysis of centralized control and distributed control of a building environment using wireless sensor and actuator networks. The simulation results shows that distributed control scheme is having advantage of less packet loss and low computational complexities [38].

Limitation: Simulation based results are compared for both types of control systems but no actual implementation of the system in building have been discussed.

J. Liang et al. presents an intelligent control system design for HVAC system. The design is achieved with the combination of human learning and comfort levels. The simulation of the system confirms the better results for proposed design [39].

Limitation: Paper describes simulation for HVAC system and the results have been evaluated, but hardware complications are not considered.

Ling, S.H. et al. purposes a hybrid particle swarm optimization approach to control the appliances [40].

Limitation: The proposed system is about controlling only dimming of light in a room but other parameters are not considered.

Dipak Surie et al. discusses a ZigBee based wireless sensor networking of 42 everyday objects in the smart home environment and information processing [41].

Limitation: The proposed system is about the monitoring of different home appliances with wireless sensor network but the control part is missing.

Lili Liang et al. proposes ZigBee and PSTN based remote control. System is designed using PIC18LF4620 SCM and 2.4GHz RF transceiver module, for smart home [42].

Limitation: Paper proposes PIC controller with 2.4 GHz RF module but AVR could be more cost effective solution for the system.

Fu, Yue et al. provides a solution to the problem of uncertainties in the systems. It is done by developing an intelligent network using multiple nodes and neural networks with the help of a set of fixed controllers [43].

Limitation: Neural network based system is developed to solve the problem of uncertainty in the system without users intervention about their comfort, but this a complex approach.

Ivan Vilović et al. says, Demetreseu and Italiano's algorithm is for maintaining all shortest paths with general real valued directed graphs and non- negative edge weights [44].

The paper also mentions, PSO starts with a group of random particles (solutions) and then searches and updates optimum values [44].

Limitation: Theoretical description with simulation part for different optimizing algorithms are discussed without actual implementation on hardware.

Quijano. N et al. presents test beds to compare the simulation results for different distributed controls. The test beds provides a platform to study the design and implementation of distributed networks for control, without actual hardware resources [45].

Limitation: A test bed is designed for different control methods without actual hardware involvement.

Luskin et al. relates the development of an intelligent central controller to mitigate harmonic distortion in single phase circuit due to non- linear AC loads [46].

Limitation: Invention is related to single phase circuit, but doesn't include the performance analysis of controller.

Dong Hwa Kim et al. proposes a new approach in the form of EU-GA-PSO to find out optimized solution to tune PID controller for automatic voltage regulator [47].

Limitation: Paper proposed a new tuning method with GA and PSO on AVR system, but doesn't include actual building parameters.

Jun Zhao et al. discusses the tuning of PID controller with the help of particle swarm optimization, to reduce the overshoot for non-linear and non-differentiable problems. The proposed method is compared with existing PID tuning method and result validates the better performance of the proposed model [48].

Limitation: Paper discusses the development of test bed for performance analysis of PID-PSO tuning method, but no actual hardware application is developed**.**

Lee, K. Y. et al. presents a test bed to simulate the system designed for home automation to provide comfort to elderly and disabled people. The system is designed by using Bluetooth technology [49].

Limitation: Paper discusses the home automation system via Bluetooth, which is a licensed network.

W. Huang et al. proposes a genetic algorithm for automatic control of PID controller in HVAC systems. Simulation results show genetic algorithm gives better results with system when compared to existing techniques [50].

Limitation: Paper describes the combination of GA and PID for HVAC systems but it only shows simulation results, hardware implementation is not included.

2.2 Conclusion from Literature Review- Referring the papers from various reputed journals on nonlinear systems with level control, following points are concluded-

- It is concluded that PID controller is used to set Kp, Ki, Kd values to control the system.
- The power consumption can be reduced by using optimizing techniques with PID controller.
- Levels of appliances can be controlled with dimmer circuit.
- Remote control for individual appliance is found in previous art.

2.3 Chapter Summary

The chapter discusses the already existing art by referring various research papers published in reputed journals. It includes the conclusion from existing art and research gap to define the problem and its methodology. It is concluded that the power consumption by the system can be reduced by using some optimization algorithm with PID controller.