A Framework for Load Shedding and Demand Response in DC Microgrid using Multi Agent System

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***Abstract*-This paper presents a framework of load shedding experiment for a DC Microgrid using Multi-Agent System (MAS). The microgrid uses solar panels as source of energy to serve a community without access to electricity. The generated framework includes modelling of solar panels, battery storage and loads for effective control and better operation. The loads are classified as critical and non-critical loads. The agents are designed in a decentralized manner which include solar agent, storage agent and load agent. The load shedding experiment of the framework is mapped with the manual operation done at Kisiju village, Pwani, Tanzania. The results of the experiment focus on using accurate solar and PV panels which provide: (i) the multi agent system that runs in the DC microgrid, (ii) the controlling and monitoring of power to be used for critical and non-critical loads and (ii) the management power in the production process through selling extra power from an individual load to the storage.**

I. INTRODUCTION

To achieve the growth of the countries' economy, a safe and reliable technology in the provision of smart electricity is one of the factors which have to be considered. Smart grid is one of the latest technologies in the provision of automatic electric network from generation to the end users. It includes features such as self-healing, fault tolerance and detections, demand side managements and automatic load shedding. According to[1], the smart grid is an electricity network that can intelligently and smartly integrate the actions and users connected to it (generators, consumers, transmitters, distributors and those that do both) so as to efficiently deliver sustainable, economic and secure electricity supplies. Many countries have seen and started to benefit from smart grid and applications from the grid infrastructure, healthy and agricultural sectors as well as distributed supercomputing.

In developing countries, smart grid has not yet much implemented especially to control and monitor customer's side. The Tanzania Electric Supply Company (TANESCO) which is the sole supplier company of the electricity in Tanzania, the transmission side is the part which has been implemented in the process of monitoring and controlling with smart grid and lesser extent to the primary distribution side of the grid system. There is still a need for the automation process in the control of electric power so as to increase efficiency in all aspects of the electric power system, optimize cost to consumers and reduce human power and errors. Also, the use of renewable energies such as solar and the wind are more valuable in the utilization and provision of electricity in places without access to the national grid. When the smart network system has been integrated with renewable energies as a source of power, this is referred to as *smart microgrid*. According to [2], microgrid system are capable of rapidly detecting, controlling, managing, analyzing and responding to various perturbations in the network by integrating advanced control methods such as agent based systems.

The control and management of distributed energy systems using multi agent systems in smart grid have been seen to work effectively in the provision of autonomous actions. According to [3], "An agent is a computer system or device that is situated in some environment and is capable of taking autonomous action in this environment in order to meet its design objectives". The system which has more than one agent working together is referred to as multi agent system. The study by [4] discussed that, agent based system can be applied in the management of distributed energy systems including demand side management, storage and generation. Other sectors by which multi agent systems can be applied are e-healthy, transportations and infrastructure.

This work uses accurate solar and PV models to show the impact on the control and monitoring of dynamic loads power consumption compared to static loads discussed in [5]. Also, the demand response with respect to power is discussed where by an individual load can provide extra power to the main storage for continuous production. Our paper is structured as follows: Section II describes related work. Problem Statement will be described in Section III. The methodology of our experiment will be elaborated in Section IV. Section V will be discuss the simulation results. Finally, Section VI concludes our paper.

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