Automated Water Distribution System using LabVIEW

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***Abstract*—An effective and reliable water management system for towns and cities is necessary for minimizing water wastage, energy consumption and fair distribution of water to all consumers. This paper presents the development of a simulation model of a water distribution system based on a fixed scheduling approach for urban areas using LabVIEW. This system enables automated control of water supply to various wards considering water levels of main and auxiliary tanks, priority zones and consumption levels. The proposed simulation model can be used to identify any inefficiencies and improve infrastructure, operational planning and scheduling of water supply to the consumers.**

***Index Terms*—Automation, LabVIEW, simulation, water management system**

I. INTRODUCTION

Managing an urban water distribution system is becoming more challenging these days because of aging infrastructure, fluctuation in water demand and increasing water demand due to fast growing population. Conventional water supply control methods such as manual operation of valves involves human error and often results in an inefficient system due to high pressure in pipes, water and energy wastage. Hence there is a need for an automated water distribution system that eliminates human errors leading to a fair, safe and reliable allocation of water resource. The above mentioned problems are addressed by the developed simulation model of the automated water supply management system using LabVIEW, which is a graphical programming tool that is user friendly. The model can be used by managers to plan for maintenance schedules and test the system for different distribution strategies.

II. LITERATURE SURVEY

The paper, [1] discusses an automatic water tank filling simulation using LabVIEW. The simulation models the water tank system and provides insights into its operation. While the focus is on simulation, the principles can be applied to automated water supply distribution systems. [2] discusses the design of a water-saving irrigation monitoring system using a ZigBee wireless sensor network and a LabVIEW simulation platform. The system employs fuzzy control decision supports to manage irrigation schedules, aiming to optimize water usage in agricultural applications.

Various hydraulic modelling approaches tailored for intermittent water supply systems are examined in [3]. The paper discusses different modelling techniques, including one-dimensional simulations and the use of EPANET, to address challenges such as variable supply schedules and demand patterns in intermittent systems. In [4], a system based on sequential design by using discrete electronic components is introduced. The system presents a simple design of water level sensing, simulation and implementation of an automation system which is able to control the switching of the water pump in accordance to the present water level in the tank. While focused on oil pipelines, this paper

[5] discusses the design and simulation of a Supervisory Control and Data Acquisition (SCADA) system using LabVIEW. The system aims to control oil transportation through a shared pipeline, minimizing product contamination. It introduces a control algorithm for pumping station control, tank level maintenance, and depot inventory control. [6] presents an automated water supply and distribution system using Programmable Logic Controllers (PLC) and SCADA. The system aims to facilitate potable drinking water as a vital service to the public. It discusses the automation of water distribution services, including water theft monitoring, to ensure efficient water supply. [7] focuses on the application of remote smart demand meters that provide high-

frequency data for modeling water distribution systems. The study emphasizes the significance of accurate demand data in simulating and managing water distribution networks, leading to better decision-making and resource allocation. The study in [8], presents a flow rate-controlled water sprinkler system utilizing a PID controller implemented in LabVIEW and interfaced with an NI myRIO controller. Sensors such as rain and moisture sensors are used to monitor environmental conditions, enabling efficient water usage in agricultural settings.

[9] focuses on the design and implementation of a water level monitoring and control system for large buildings using NI LabVIEW. The system incorporates multiple water levels, alarms, and digital displays to manage water usage effectively in residential, commercial, and industrial settings.

III. DESIGN METHODOLOGY

The simulation model consists of mainly two tanks, a main tank and an auxiliary tank. Also, each ward has its own storage tank. Valves are present at every stage which can be used to control the flow rate between main-auxiliary and ward tanks or between ward and area tanks or from area tanks to consumers. Initially, it is assumed that both the main and auxiliary tanks are full and water is being supplied to the ward tanks only from the main tank.

Each of the tanks have an LED to indicate when the tanks are full. When the level of water in the main tank falls below 50 %, supply from the auxiliary tank is also enabled. Once the ward tanks are full, the start button is pressed which enables supply to the different areas in the respective wards based on the schedule plan. Here, supply to areas A11, A21 and A31 is scheduled on Mondays, supply to areas A12, A22 and A32 is scheduled on Wednesdays and supply to areas A13, A23 and A33 is scheduled on Fridays for a specific time.

Figure 1 shows the front panel of the complete system indicating various tanks and control valves at different stages, tank full LED indicators, LEDs to indicate areas receiving water and start and stop buttons.

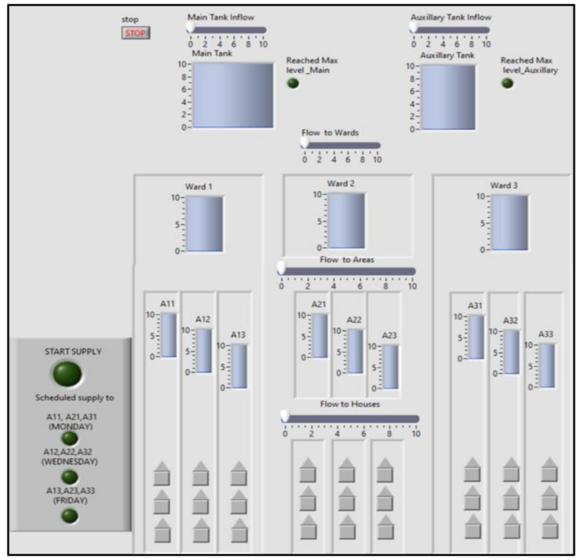


Figure 1. Front Panel

Figure 2 indicates the condition when both main and auxiliary tanks are full. Next, Figure 3 indicates the condition when ward tanks are full.

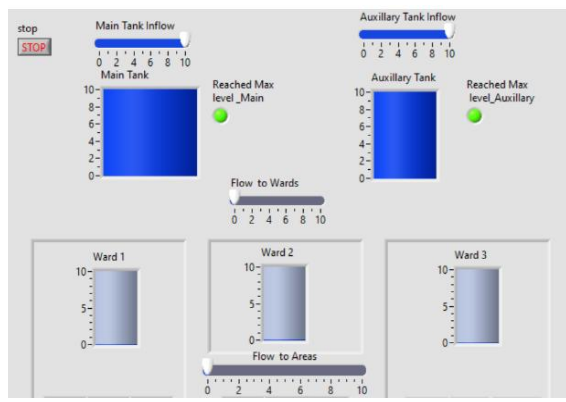


Figure 2. Main and auxiliary tanks full indication

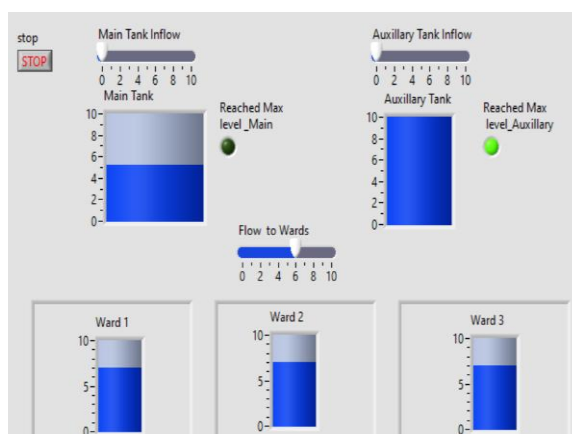


Figure 3. Supply from Main tank alone until level falls below 50%.

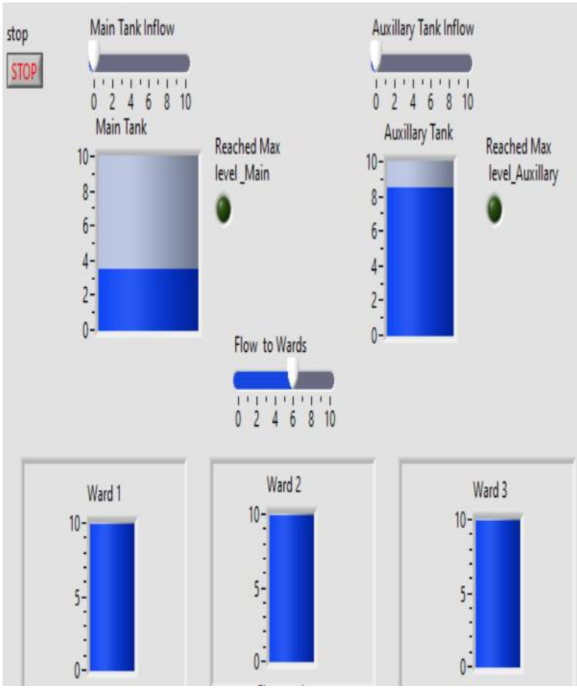
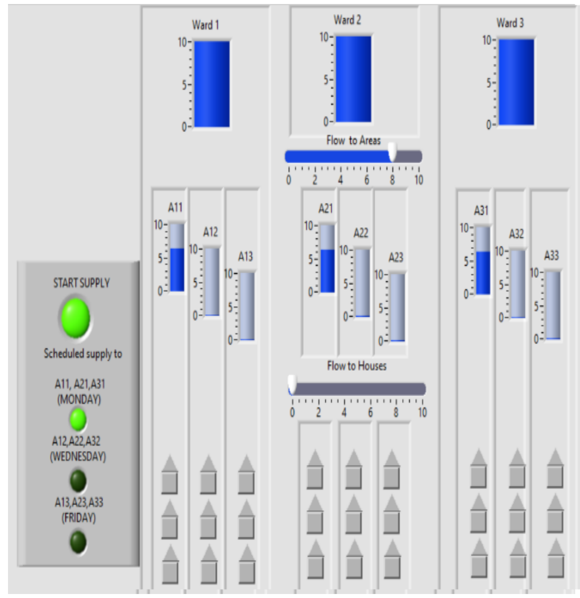


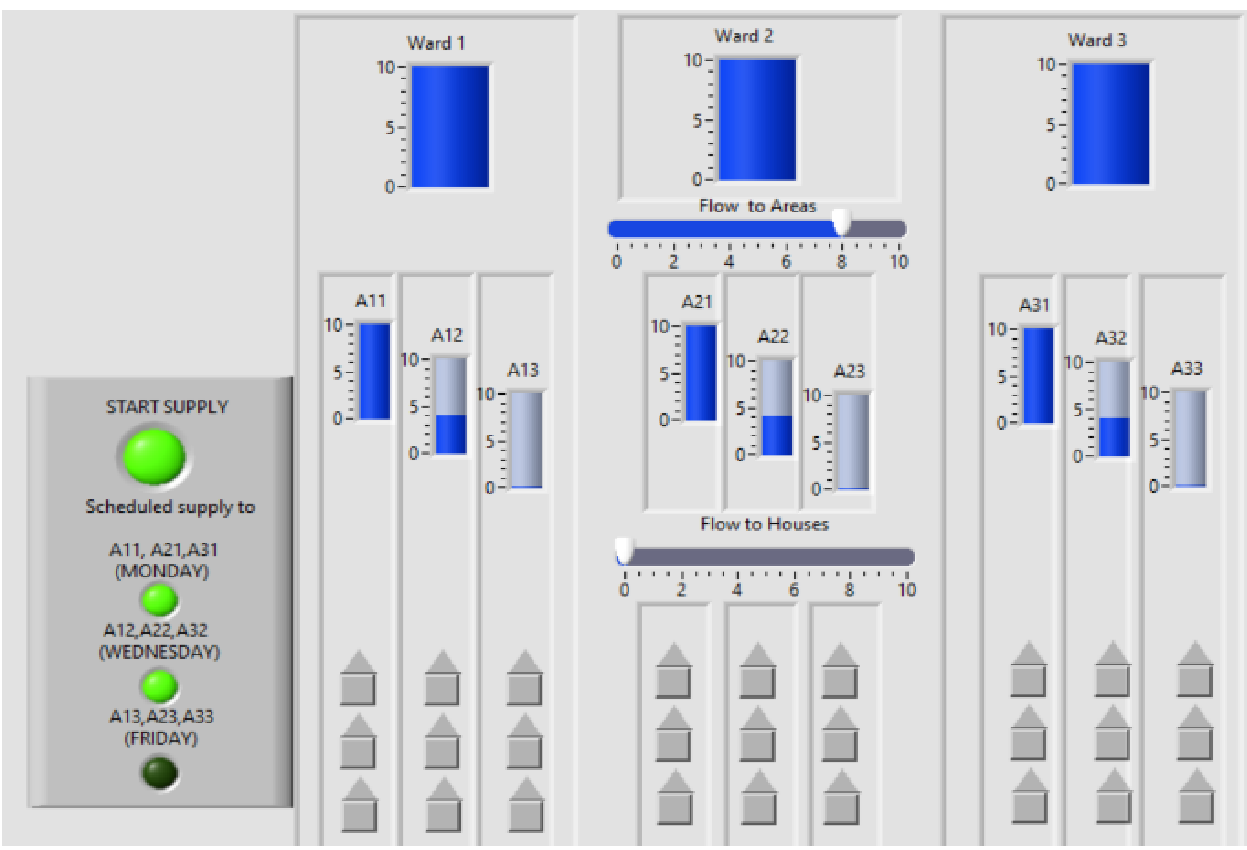
Figure 4.

Figure 4: Supply from both Main and Auxiliary tanks when level crosses 50%.

Figures 5, 6 and 7 indicate the water supply to selected areas on Mondays, Tuesdays and Fridays as per schedule. In order to assign priority to specific areas, the code can be easily changed provide continuous supply to those areas.



Figures 5



Figures 6.

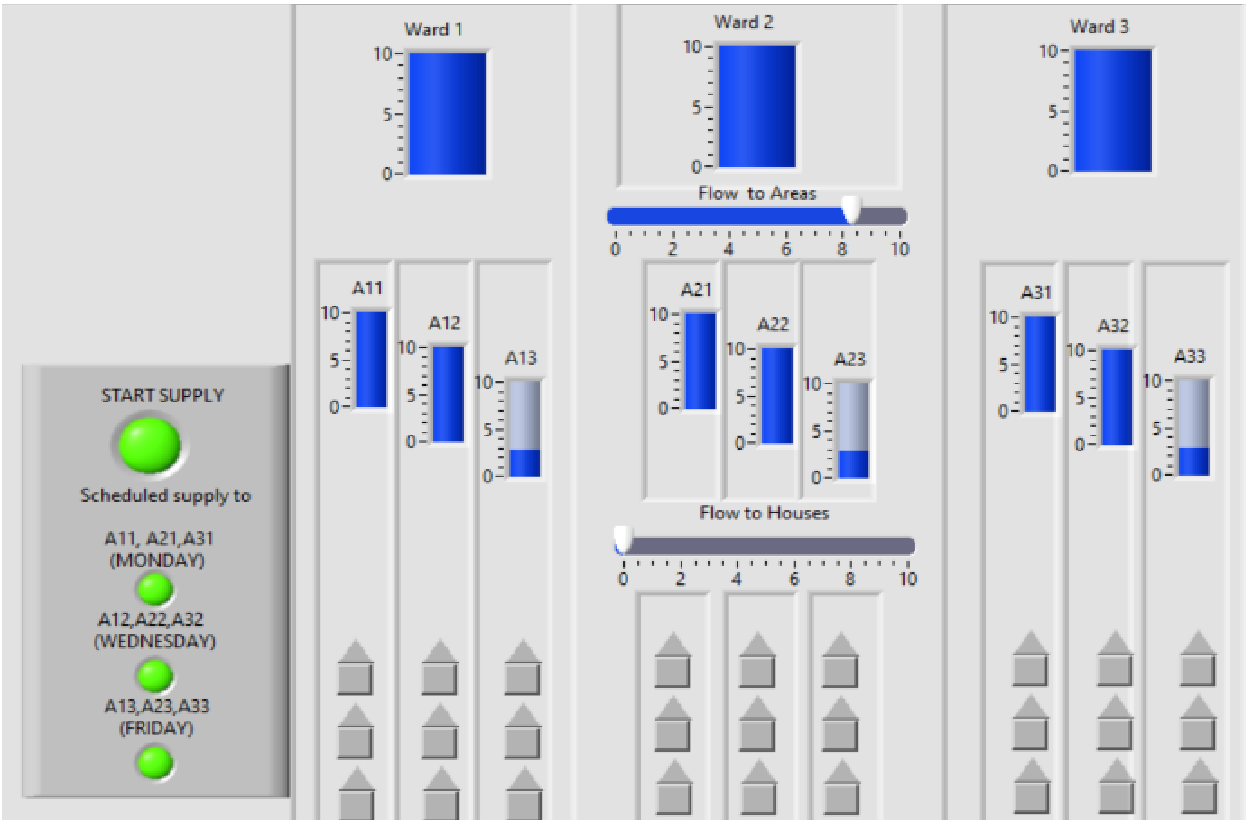


Figure 7.

Figure 8 shows the block diagram of the complete designed system.

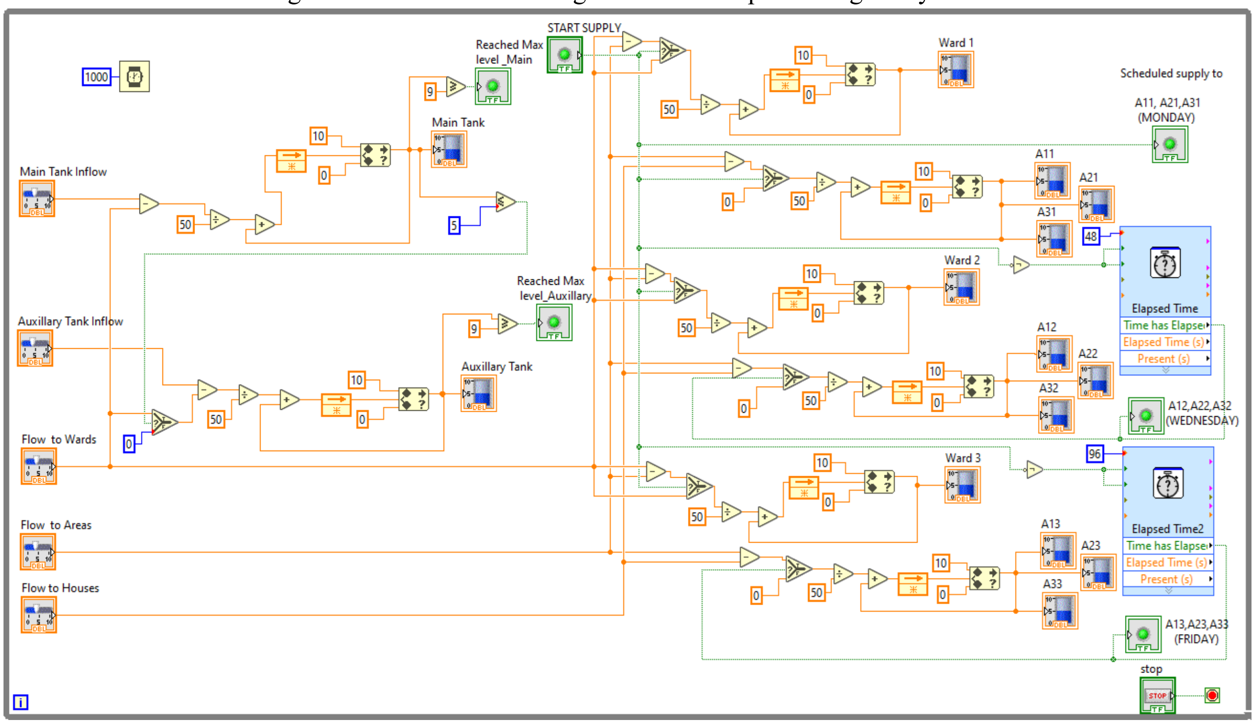


Figure 8

IV. CONCLUSION

The design and development of a simulation model for automated water distribution system using labview has demonstrated the potential of using the software tool for testing various scheduling strategies to achieve effective and reliable water management in cities and towns. Automation of the valve control through predefined thresholds, scheduling patterns and logic significantly reduces human intervention, water and power wastage and ensures a reliable water supply to prioritized zones apart from maintaining fair distribution of available water among the consumers.

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