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Synopsis on

Design, Development and Performance Analysis of Multi-Task, Multi-Tank Water Level Controller with Automated Power Supply for Multi-store Buildings

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1.1 Keywords

Electricity bills, Energy conservation, Water level indicators, Multiple overhead tank water controller, Arduino I2C interfacing, PIC-Microcontroller.

1.2 Introduction

"Water is the driving force of the nature." It's not too late to change water's fate. In India about 580 billion liters of water is wasted by tank overflow. Which is more than 30% of total water waste in India? In everyday life, water is the main element either for domestic or commercial purpose excessive water wastage has become serious issue, due to excessive wastage increase scarcity of water, which leads to increasing the water bill. The wastage of water across the various sectors such as secondary cities in India have an important role to play has hubs of economic, government, cultural and educational activity within national systems of cities they are also beginning to play increasingly important roles as cities adopt circular economy principle in the way supply chain function. In such cities, a normal residential building are one, two or three stored buildings and consists of multiple overhead tanks to which water meter is connected to the service main. In such buildings, water pumping/distribution amongst the residence and segregating the electricity bill employed for water pumping is a really challenging which leads to scarcity of energy consumption and wastage of electricity with complex issues and some of the major difficulties when water bill is higher than normal, it's important to track down the cause and correct it as soon as possible with this in mind, there are most common reasons for a high water bill due to filling of multiple tanks with single motor unit and single electric meter, leading to high bill cost. This issue exists but smart metering of water supply has not yet been implemented.

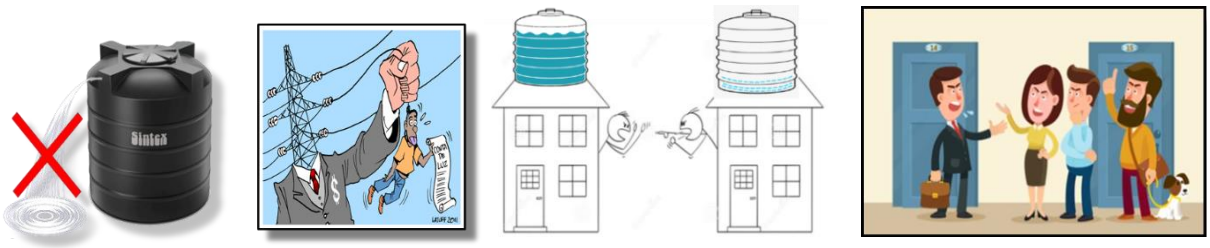

Fig. 1 Multiple Conflicts in the Present Water level Controlling and Billing System [C1, C2, C3]

1.3 Background and Motivation

In consideration with some of previous thesis and field visits to residential area and discussions with owners of the rented buildings following observations are obtained:

i. Complication in detecting water level in the tank and indication of water overflow in case of multiple overhead tanks.

ii. During water overflow we are unaware of it being inside the house which leads to wastage of water, continuous overflow of water may sometime leads to roof damages.

iii. By repeated plugging and unplugging of the switch connected to single motor which may affect the socket and sometimes burn the switch.

iv. As per the individual requirement of residents, the time for switching the motor varies in a combined 4-5 store buildings.

v. Due to the varying distribution of electric power among the residents to fill the unequal tanks brings complication among them in dividing the electricity billing cost.

vi. However there are no such commercial device application which can solve all these problems.

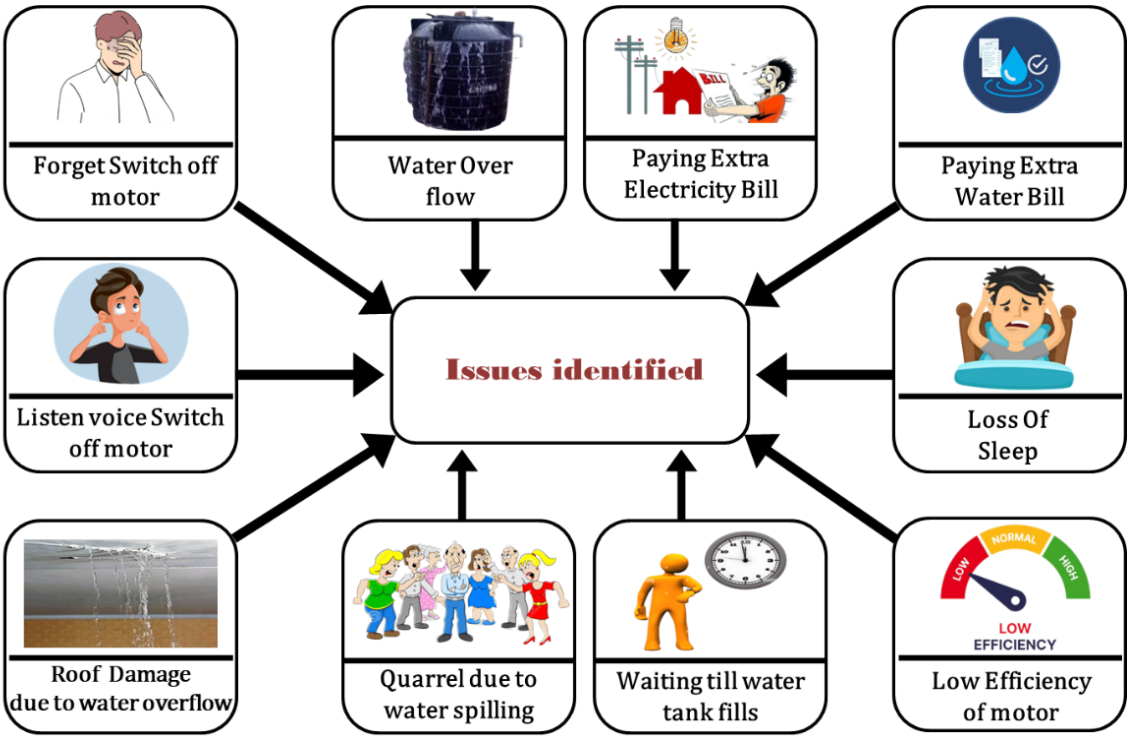

Fig. 2 Issues Identified in Present System [C4]

1.4 Objectives

Secondary cities in India have an important role to play as hubs of economic, government, cultural and education activities within national systems of cities. They are also beginning to play increasingly important roles as cities adopt circular economy principles in the way supply chains function. In such cities multi storied buildings (3 to 6 storied) provides residence to major group of occupational community. Bagalkote, Vijayapur, Badami, Guledagudda, Dharwad, Mudhol, Jamakhandi etc. are the key examples for such localities.

In such buildings, water pumping/distribution amongst the residents and segregating the electricity bills employed for water pumping is a real challenge. This issue exists because smart metering of water supply has not yet been implemented. This is addressed in the proposed project work.

Based on the rigorous literature review, field visits to residential area and discussions with owners of the rented buildings following objectives are set for the project:

- **To design and develop the multi-task multi-tank water level controller with automated power supply for multi-store building**

- **To test and analyze the performance of proposed model in a residence consisting of multiple tanks**

1.5 Proposed Methodology

i. Project Implementation-Block Diagram

The proposed methodology is divided in two parts based on the two major constraints as mentioned below:

- **The first constraint is to achieve systematic/transparent billing mechanism for respective individual connections.**
- **The second constraint is the automation of water distribution in overhead tanks by switching control to avoid overflow of water and to restrict the filling of water in alternate tanks.**

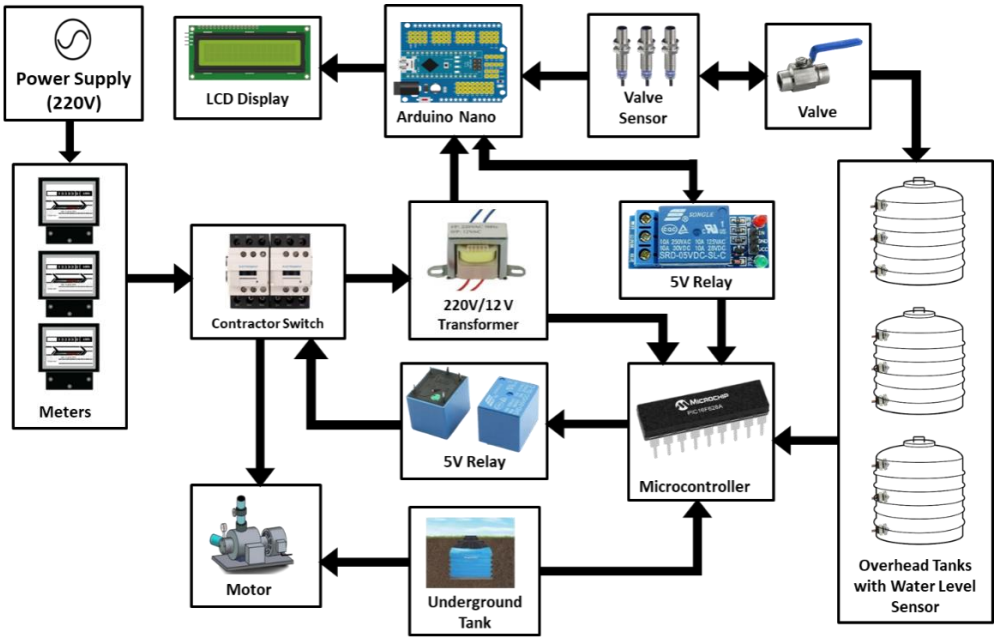

Fig. 3 Block Diagram of Proposed Model

The **first constraint** is achieved by connecting contractors that are monitored and controlled by the Arduino Pro-Mini and PIC microcontroller, combined with all the individual meters, so as to generate the separate electricity bill for the respective individual, further the **second constraint** of automation is achieved by designing a controller enclosure box which consist of PIC microcontroller, indicator valves and displayer which monitors the valve sensor and water level sensors in the overhead tanks to avoid overflow of water and filling of water in alternate or undesired tank.

ii. Project Flow Chart

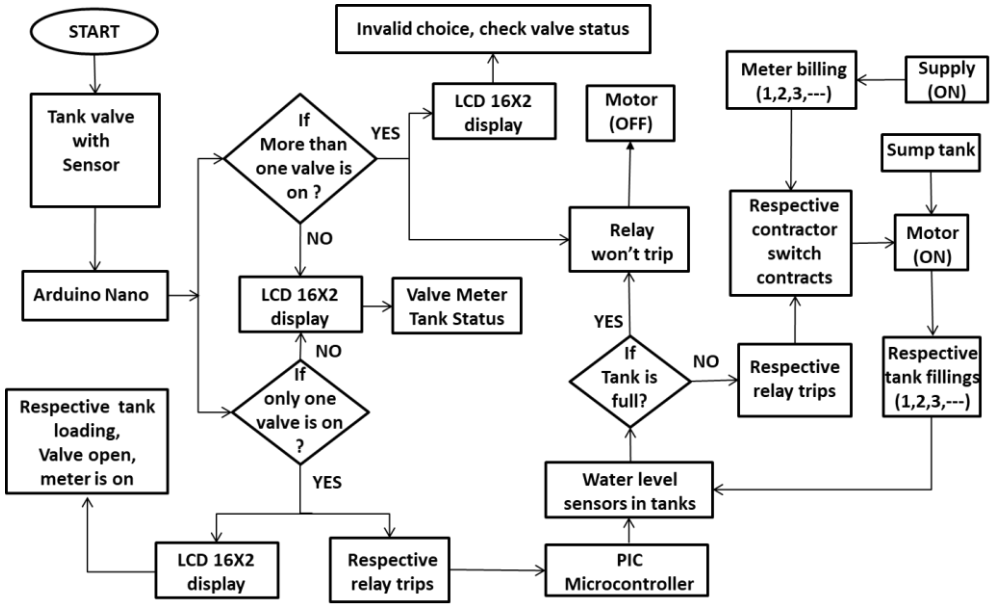

Fig. 4 Flowchart of Proposed Model

The first step up of the methodology begins with opening of the valve. The valve is connected to the sensor which sense the position of the valve and analog signal sent to the Arduino. As Arduino is connected with I2C LCD which displays the valve is on, respective meter billing and tank loading. The monitoring and controlling action of the Arduino sends its digital output signal to the respective relay for tripping action. Once the relay gets tripped the respective microcontroller gets activated. Based on the water level in the overhead tanks, microcontroller sends signal to the respective auxiliary relay for tripping action. Once the relay gets tripped, the respective contractor will contract, which switch on the motor hence the electricity bill is obtained only from the respective meter. This methodology is continuously monitored and controlled and further repeated similarly for other tanks as well.

iii. Wiring and Connection

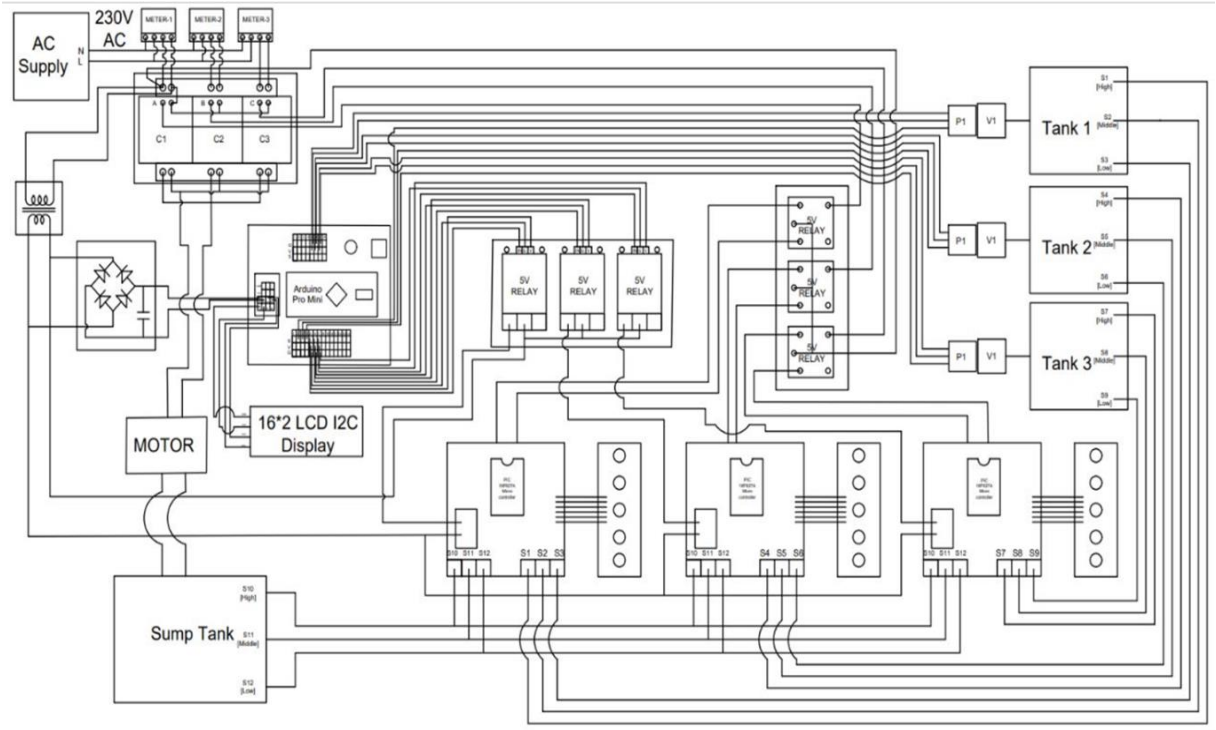

Fig. 5 Wiring Connection of Proposed Model

The project wiring & connection starts with the 1-phase AC supply which connects 3 individual electric meters to the respective contractors. A common point from the contractor is given to the AC motor (18W). Another common input terminal from the contractors is sent to an auxiliary 12 V transformer.

One of the outputs of the transformer is connected to the Arduino through bridge rectifier; other output is connected to the PIC microcontroller which consists of in-built bridge rectifier. Arduino expansion adapter set consists of 3 interlinked connections to Arduino pins. One of the connections to the Arduino analog pin comes from sensors present in the valve. The 2nd& 3rdconnections digital pins of the Arduino are connected to the relay (5V DC) & I2C interfaced LCD respectively. The outputs of relays are given to the respective PIC microcontroller. The water level sensors in the overhead tanks are connected to the input of the PIC microcontroller. The output is sent to another set of auxiliary 5V DC relays. Further the outputs of the relays are connected to input of contractor.

iv. Steps Involved in Project Methodology

STEP-1: Sensors designing, program formulation with software interfacing.

STEP-2: Assembling and wiring of the components to the base metal sheet.

STEP-3: Examining proper supply and wiring connection of the devices with the Arduino.

STEP-4: Positioning and laying up of the supportive structures for the proposed model.

STEP-5: Clamping and assembling and demonstration of the final demo model.

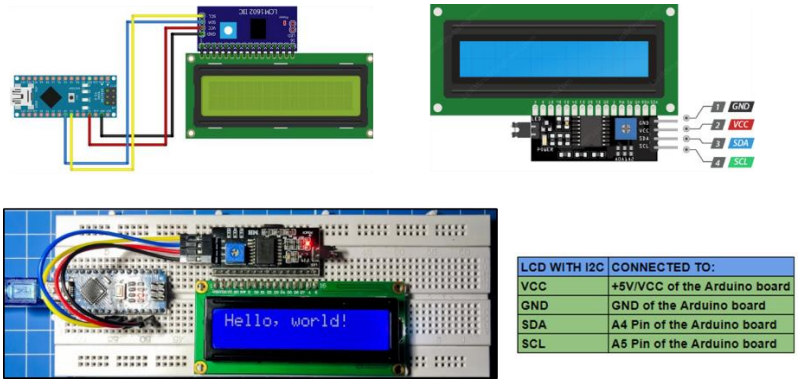

Fig.6 Arduino Nano and I2C LCD Interfacing [C5]

Fig.7 Testing of the Proposed Model with all the Components and Constraints

1.6 Results

The proposed model of the project was tested and analyzed and the following results were obtained under the different valve constraints are mentioned below:

Residential Building Valve Status			Motor Status	Meter Billing Status		
V1	**V2**	**V3**		**M1**	**M2**	**M3**
ON	ON	ON	OFF	OFF	OFF	OFF
ON	ON	OFF	OFF	OFF	OFF	OFF
ON	OFF	ON	OFF	OFF	OFF	OFF
ON	***OFF***	***OFF***	***ON***	***ON***	OFF	OFF
OFF	ON	ON	OFF	OFF	OFF	OFF
OFF	***ON***	***OFF***	***ON***	OFF	***ON***	OFF
OFF	***OFF***	***ON***	***ON***	OFF	OFF	***ON***
OFF	OFF	OFF	OFF	OFF	OFF	OFF

1.7 Conclusion

Multi-Tank water level controller for multi-store buildings with single motor system is developed at BEC Energy Park. The Proposed demo model is designed and installed successfully. Further the performance of the proposed model was analysed and tests were conducted with different possible constraints of the valve and as well as the water level in the tank.The different results obtained during the performance conclude that the motor is on and billing is obtained to respective meter only when single valve is open and water level is below the top level.

1.8 Future Scope

The designed multi-task water level controller is major key aspect for filling multiple tanks, the developed model proves to major success for billing and monitoring the water level. The model can be further implemented and improved in some of aspects by using alternative sensors and control and monitor the system using IoT for automation through mobile apps. Some the features of the proposed model product can be varied for its better performance.

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