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BUILDING WATER AND LPG MANAGEMENT SYSTEM

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ABSTRACT

The Building Water and LPG Management System are designed for the residential, hotel, and hostel buildings that are to be constructed. This project tries to provide the integrated least-cost solution for LPG and Water management. By implementing this project the user will have all the information of the water and LPG being used by him in his palm. The project is classified into three parts. The components used for this project are also very cost-efficient and thus make it possible for even already constructed buildings to implement it, with minimal structural changes. Water and LPG both are precious resources and having the right information about it's also helps people to pay attention to how they can reduce the use for a better tomorrow.

Keywords: Water Management, Lpg, Raspberry Pi, Telegram Bot.

I. INTRODUCTION

LPG is widely used in various fields such as for domestic cooking, heating purposes, and many other industrial applications. On construction sites, LPG is found in cylinders rather than bulk storage vessels, which are used when LPG is the main source for supplying central heating and commercial applications. In apartment buildings, these are stored in a cabin, which consists of cylinders of every house. This arrangement is made to prevent any mishap that can take place by individual apartments. By keeping all cylinders in one cabin, proper ventilation can be provided for just one room, instead of every apartment. This also makes transport of cylinders easy, as we do not have to carry them to the apartment. This usually leads to exhausting gas entirely and then realizing to book LPG.

From a water management perspective, however, the interest is in how we manage and monitor the water use in buildings. Specifically, the focus is to develop a system that will allow us to collect data on the use of water and provide information to users. Monitoring and managing water use also help as a part of the larger effort of measuring and verifying a building's performance. The water management system monitors and manages water usage that will change the process of mere supply of water to the people to meet their daily needs. How the commercial buildings use water varies by building type, restrooms, the type of plumbing fixtures, landscaping needs, the type of cooling systems, kitchens. USGBC proposes a method of estimating a building's water use. In new buildings, the use of water is determined by estimating the building occupancy; for buildings that are already constructed, it's past water use records.

II. METHODOLOGY

The entire system is centered at the Raspberry Pi Pico. Raspberry Pi Pico has been designed to be a low cost but still a very flexible development platform for RP2040. This controller is interfaced with ESP32 Module, This is the WiFi module being used in this project to connect to the devices to provide information to users wirelessly. All the Devices connected to this WiFi will be able to access the data in their telegram application using the telegram bot created for this purpose. The same data can also be got by looking into the Screen which will display the information on the main notice board. The Flow Sensor is used to get information about the amount of water being used by each house. Two separate flow sensors will be used for each house, while one of them calculates the amount of hot water and the other one will calculate the cold water being consumed in the house. The temperature sensor is used to make sure that the hot water consumed by the house is hot enough and no cold water is sent through the hot water pipeline. This is a common problem observed in the building, where one house gets hot water, while the other does not. The water from the solar water heater is passed onto a hot water tank, only when a certain temperature is reached. This ensures that no house is deprived of hot water.

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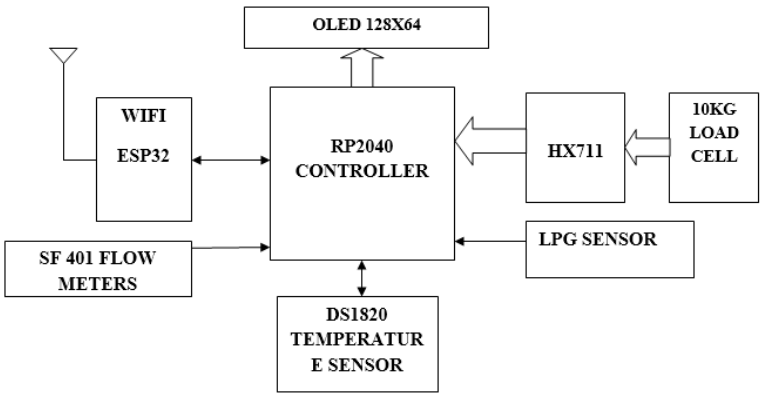

Figure 2.1: Block Diagram of the system

The load cell gives a small electrical signal based on the weight being applied to it that is sent to the Hx711 amplifier to amplify the signal from the load cell, which is then sent to the raspberry pie where the actual weight of the LPG cylinder weight is measured. The LPG sensor is the MQ4 sensor, which is used to sense any leakage that might take place in the LPG storage area. This helps to avoid any mishap from taking place by notifying the residents in advance.

III. MODELING AND ANALYSIS

The project is mainly divided into three parts, based on the function performed. Water Management, LPG Management, and User Communication are the main three modules of this project.

Water Management Module

This module is responsible to manage the water resources of the building. This module consists of flow sensors, temperature sensors interfaced with the Raspberry Pi Module. The flow sensors are used to calculate the amount of water used by each house. Each house has two flow sensors, which are connected to the main pipeline of that house. One for the hot water and cold water each. The amount of water used by each apartment is stored in the raspberry pi. The Temperature sensor is used to check the temperature of the water. The program is written in such a manner that it makes sure, that bill is generated according to the use of hot water. If a particular house gets cold water, instead of hot water, the price equivalent to cold water is charged instead. Figure 3.1 shows the model of water tanks, in which the tank on right is for the hot water and the one on left is for cold water.

Figure 3.1. Water Management Module

LPG Management:

This module is responsible for measuring LPG gas weight and detecting gas leakage. This module consists of a load cell, HX711 module, and MQ4 sensor interfaced with the Raspberry pi module. The load cell is used to constantly measure the weight of the LPG cylinder and with the help of the HX711 module stored the information of the weight of the LPG cylinder in Raspberry pi. If the weight of the LPG cylinder goes down a certain limit an alert message is sent to the user indicating that the gas level is low.

The MQ4 sensor constantly measures the concentration of any gas leakage around the LPG module, if there is any kind of leakage and the concentration level of the leaked gas reaches a certain limit an alert is sent to the user indicating there might be a potential gas leakage happening.

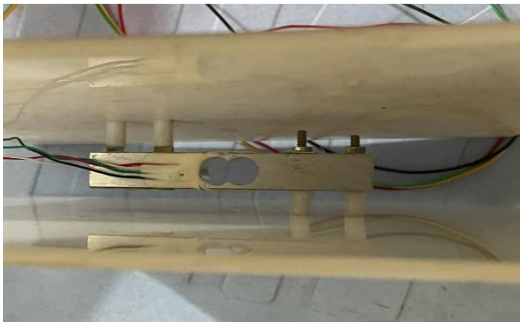

Figure 3.2 Weighing Sensor for LPG Cylinder

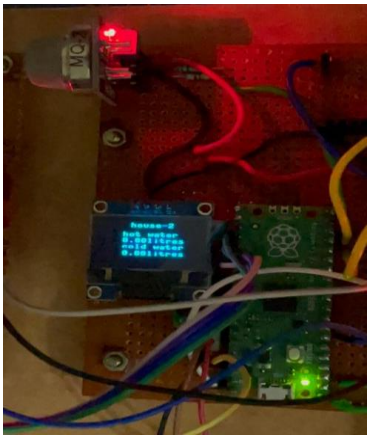

Figure 3.3 LPG Leakage Detection interfaced with Raspberry Pi

Communication Module:

The user interface is possible only through this module. An ESP32 WiFi module is used for this purpose. The data from the LPG and Water Management Module will send data through Wired Interface. This data is stored in the Raspberry Pi. The User can get the data using a telegram bot, by sending simple messages. On receiving these messages, the data is sent back, to the telegram bot. An OLED screen is also provided which will be placed at a place accessible by all the people for display without the use of Telegram Bot, for the benefit of those who don't own a smartphone that supports Telegram. The Telegram is app is used, as installing a separate app, usually annoys the user and also takes up precious space in the mobile devices.

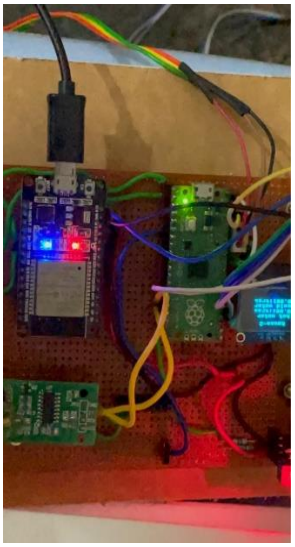

Figure 3.4 ESP32 and OLED Interfaced with Raspberry PI

IV. RESULTS AND DISCUSSION

The embedded system designed with the above specification gives an output with how much water(hot&cold) is consumed in each house and this is reflected in the OLED display and with the help of the Wi-fi module and Telegram linked to it, the output will be shown on demand of the house 1 we need as shown in Figure 4.1. Similarly, the usage in house 2 can also be obtained.

Figure 4.1 Home 1 Water Usage

Similarly, LPG is also monitored and results are obtained as shown in Figure 4.2 of each house. When the amount of gas below a threshold set by the user, a notification is also sent to the user as shown in Figure 4.3, prompting him/her to book for a refill of the LPG cylinder. This ensures that there is a continuous supply of LPG and that day to day activities of the user do not come to a halt, due to such a petty reason. Leakage and shortage of LPG are directly pinged to the Telegram ID as shown in Figure 4.3.

Figure 4.2 Gas Availablity Information

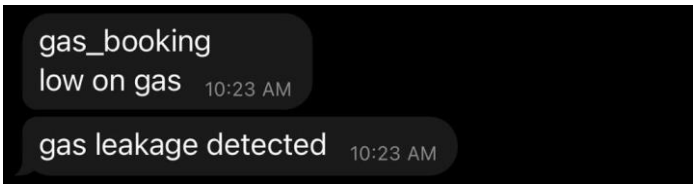

Figure 4.3 Automatic Notification of critical events

V. CONCLUSION

The design of the Building water and LPG management system is implemented and tested successfully. This project helps not only to manage the water bills based on the usage of each house but also helps people realize the quantity of water that they use, which is not easy to gauge otherwise. People often underestimate the amount of water used by them. Having actual numbers in their hands will motivate the users to use less water and save it for the future generation. From this design, we can implement it in Buildings, houses, and apartments. In the future, this prototype will be converted into a product so that in all apartments it can be used to prevent a centralized solar water heater and better manage the centralized LPG Chamber.

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