Developing an Integrated Water Management Infrastructure in Homes

Abdelrahman Mustafa (ELE) (53506) Badria Ramadan (MCE) (56114) Bayan Jijakli (CVE) (52928)

Situation

As the world population is predicted to increase (see figure 1), the human consumption to sources of life; such as food and water, will increase [1]. However; the freshwater withdrawals have tripled over the last 50 years and predicted to increase even more in the future due to the increase in its demand [2].

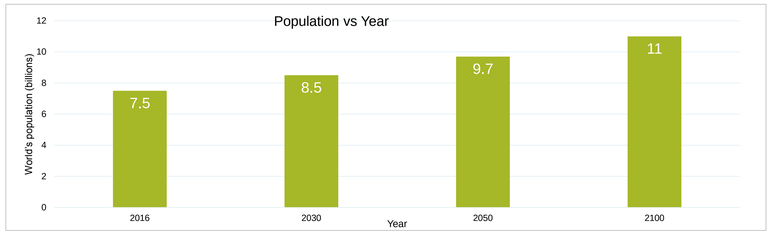

Figure 1: Prediction of world population growth [1].

Problems

- Governments are currently facing a water shortage problem mainly due to high consumption of water at homes [1].
- 70% of the consumed water at homes is gone to waste [2].
- Gray water; slightly dirty water, is not separated from black water; heavily dirty water, and treated as one stream in sewage treatment plants.

Solutions

A plan to reduce, recycle and reuse of water is suggested, where controlling the usage, storage and filtering of wasted water is to be accomplished by designing an **Integrated Water Management Infrastructure in Homes.** Which can be implemented through the following three stages:

1. Modifying the existing home pipeline system (as shown in figure 2) by implementing the following:
    - Separate pipeline for gray-wasted water
    - Separate storing tank for recycled water
    - Separate pipeline for delivering recycled water
    - Additional supply of recycled water besides hot/cold water supply
    - Efficient pumps
    - Energy saving pipe material

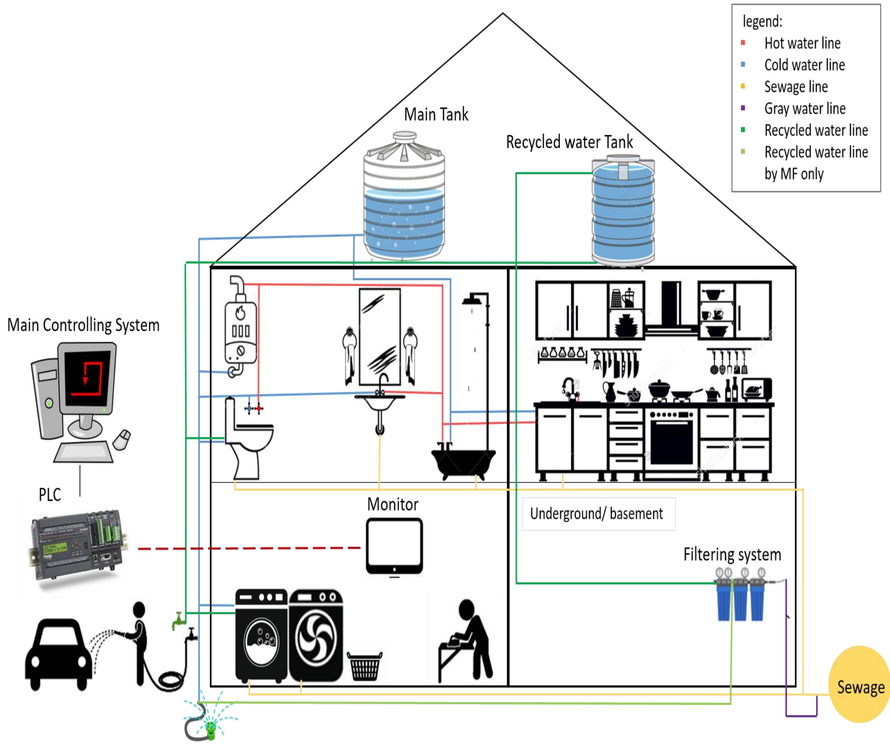

Figure 2: suggested modifications to home's water pipeline system.

2. Gray water-Filtering system (as shown in figure 3):
    - Reverse Osmosis filter:
        - Discharge points: toilet flush, washing machine, parking/Car Wash (exterior services).
    - Membrane Filter:
        - Discharge point: watering the lawn (agricultural purposes).
    - Secondary Chlorine Disinfection:
        - Used after previous filters to inactivate the microorganisms (Pathogens) that can grow in pipes when transporting the water.

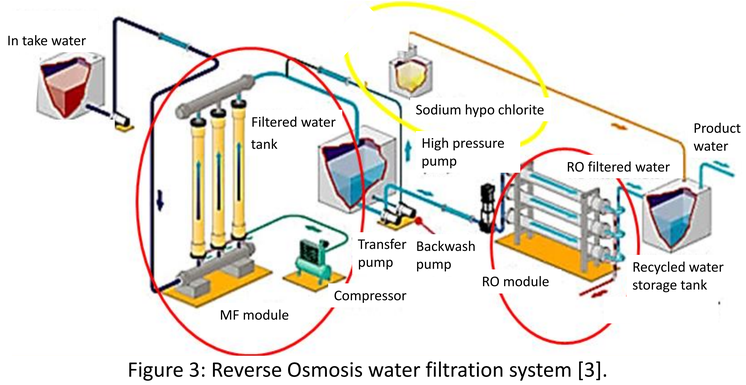

Figure 3: Reverse Osmosis water filtration system [3].

3. Electrical controlling system (as shown in figure 4):
    - Obtaining and processing data :
    - The brain of this system is the Raspberry pi; a very powerful microcontroller, that is to be used to calculate the amount of water consumed and supplied in real time.
    - A microcontroller is a computer unit that can be connected to external devices in which it converts analog signals to digital signals and vice versa according to the needs of the system.
    - Controlling external peripherals:
    - Such as; electromagnetic valves, motor, PLCS and water level indicators.

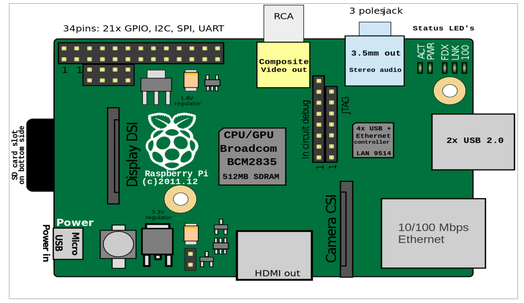

Figure 4: Microcontroller [4].

Evaluation

Pros

- The filtering system is easy to install, maintain and its power requirements are minimal. Also, It can save costs in the long run.
- The Raspberry pi (microcontroller system) is very cost efficient and contain various ports to connect the peripherals. In addition it has high processing power around 0.9-1 GHz and 1 GB of RAM [5].

Cons

- It is costly to install the R.O. filtering system at first and the filters need to be maintained regularly (every 6 months to 2 years). Also, high pressure needed for high water recovery.

References

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