Smart Fire Extinguishing System (SFES)

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Situation

Most buildings in UAE are complying with the safety standards related to fire accidents to ensure safe accommodation for the residents. Hence, most buildings use water-based sprinkler system for fire extinguishing, as shown in Figure 1. However, the simplicity and the common use of this system doesn't mean it is impeccable.

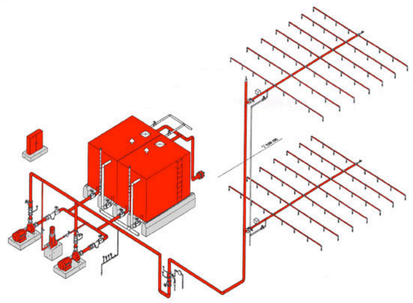

Figure 1: Fire sprinkler system diagram [1]

Disadvantages of the current systems:

- Water can cause irreparable damage to expensive equipment.
- Traditional water sprinklers release more than 25 gallons per minute. [2]
- Using smoke detectors can cause false alarms and time delay in detecting fires. [3]

Problems

The most critical challenges in this project:

- The used chemicals must not be hazardous.
- The chemicals for fire extinguishing shouldn't require costly and time-consuming cleanup after discharge.
- The system should not deplete oxygen levels to a threshold that is intolerable to humans.
- The pumping system should be reliable and fast to maintain the fire before growing.
- The system should fasten the cooling process.

Solutions

We are proposing a Smart Fire Extinguisher System in buildings, as an alternative to the traditional system, which:

- Includes multi-sensor detector, which is the most reliable fire detector, as shown in Figure 2.

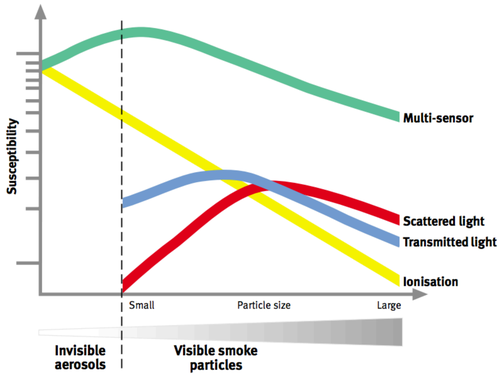

Figure 2: Fire detectors comparison [4]

- Sets off alarms and automatically sends alerting messages for all residents.
- Shuts off air conditioners automatically for more isolation.
- Extinguishes fire safely even with incomplete evacuation.
- Uses water mist and nitrogen as complementary extinguishing agents, the emitter shown in Figure 3:
  - For smaller fires, the nitrogen is the primary extinguishing agent and reduces the oxygen to a level that is still breathable, but cannot sustain combustion.
  - For larger fires, the ultra-fine water droplets cool the fire by absorbing the heat and reducing available oxygen [5].

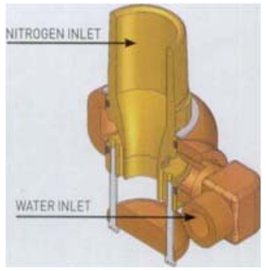

Figure 3: Cross sectional of the emitter [5]

- Allows using long-lasting plastic pipes due to the low pumping pressure.

Evaluation

Why is it important?

- Exploit advanced technologies for fire facilities and other emergency services.
- Keep the UAE high reputation in tourism by providing higher safety standards.
- Save lives and reduce fire damage by cutting off the high cost of time by manually eliminating fires.
- Increase heat absorption 90 times greater than the traditional sprinklers [5].
- Use 97% less water than the tradition system. [5]
- 100% environmentally friendly.

How is it tested?

- Using online simulations as well as real life modeling experimentation, as shown in Figure 4.

Figure 4: Real life modeling [6]

Why is it not implemented yet?

- Due to its high cost, as shown in Table 1.

Fire Sprinkler [7]	***Sprinkler system***	***Smoke detector***	***Average total price***	***Water consumption***
	1.61 $/ft^2	57.5 $	139.11 $	25 gal/min
SFES	***Chemicals***	***Multi-sensor detector***	***Average Total price***	***Water consumption***
				1 gal/min

Table 1: Cost analysis

References

[1] "Argus Fire Protection - Fire Protection Services And Equipment". Argusfire.co.nz. N.p., 2016. Web. 7 Nov. 2016.

[2] W. Reilly, "Thinking Outside the Sprinkler", *Mechanical Engineering*, vol. 132, no. 4, pp. 20-21, 2016.

[3] D. Gutmacher, U. Hoefer and J. Wöllenstein, "Gas sensor technologies for fire detection", Sensors and Actuators B: Chemical, vol. 175, pp. 40-45, 2012.

[4] 2016. [Online]. Available: http://bells-security.com/pojsistemi/MultiSensor.pdf. [Accessed: 12- Nov- 2016].

[5] "Victaulic Vortex Fire Suppression System Extinguishes Fires with Minimal Disruption | Victaulic", *Victaulic.com*, 2016. [Online]. Available: http://www.victaulic.com/en/businesses-solutions/solutions/hybrid-fire-suppression-technology/. [Accessed: 12- Nov- 2016].

[6] "Fire Test Modular Type Fire Extinguisher 5kg capacity", *YouTube*, 2016. [Online]. Available: https://www.youtube.com/watch?v=RjGRfMfJXEM. [Accessed: 12- Nov- 2016].

[7] "Learn how much it costs to Install Fire Protection.", *Homeadvisor.com*, 2016. [Online]. Available: http://www.homeadvisor.com/cost/safety-and-security/install-fire-protection/. [Accessed: 12- Nov- 2016].