

Hong Kong Student Science Project Competition 2022

Extended Abstract (Invention)

Team Number: JAPE299

Project Title: Beware of Gas Leakage!

Project Type: Invention

To our best knowledge and after thorough literature research, as at 30/06/2022, there ~~are~~ are no* similar works. If there are, the reference links are as below:

The enhancement our project has made for the existing related products or research is summarized as below:

***Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.**

I. Background

There is often news about accidents caused by gas leakage at homes of elderly. As their senses are weakened due to ageing, they may not be able to notice the gas leakage. This could result in accidents such as fire and explosion, threatening not only their lives, but also the lives of their neighbours. Thus, we would like to create a device which detects excessive town gas in air and provides alarms to the elderly so that they could notice the gas leakage and avoid potential dangers.

II. Objectives

Nowadays, there has been an increasing figure in the number of elderly people who live alone and they could not take care of themselves all alone. At the same time, due to the lack of care for them in the society, it is easy for the elderly to have accidents at home. We realised that there is a call for action to help these vulnerable elderly and we would like to address this problem and protect innocent lives from danger with our device.

Therefore, our main objective is to create a device that could alert the elderly people in case of gas leakages so as to prevent accidents.

III. Methodology

(a) Working principles of a gas sensor

According to the website of Towngas, in Hong Kong, town gas contains 16.3%-19.9% carbon dioxide, 1%-3.1% carbon monoxide, 28.2%-30.7% methane, 46.3%-51.8% hydrogen, 0%-3.3% nitrogen and oxygen. Among the gases, methane and hydrogen are flammable and explosive. The gas sensor MQ-2 could be used to detect the specific compounds, methane and hydrogen, inside town gas. Because of the unavailability of handy town gas for testing, as well as to prevent dangers of fire and explosion, a similar gas sensor MQ-135 is be used to detect alcohol gas for testing and demonstration.

(b) Concepts of electric circuit on a breadboard and connection of the electronic components

Because of the needs to connect the micro:bit, the gas sensor, several LEDs and several buzzers together, a solderless breadboard would be used.

(c) Programming of the micro:bit

After building the circuit, the micro:bit needs to be programmed to obtain and analyze readings from the gas sensor, and then to alert the users by the LEDs and buzzers connected.

(d) Calibration of the sensitivity of the gas sensor

The MQ-135 could detect gases like ammonia, sulfur, benzene, carbon dioxide, and smoke. Therefore, a calibration by measuring the background reading would be necessary.

According to our experiment results, normally, the range of background reading and the readings when exposed to alcohol gas are found. The initial sensitivity is set accordingly so that alarms should be set off when there is alcohol gas in front of the gas sensor.

IV. Design of Invention

A micro:bit connected to a gas sensor would be used to detect the town gas in air. It is also connected with several LEDs and buzzers to provide reminders and warnings to residents to react quickly. They are all installed on a house model for demonstration. The gas sensor is placed above the gas stove in the kitchen, while LEDs and buzzers are placed in different areas of the house such as living room, dining room and bedroom.

In case of gas leakage, all the LEDs would light up all over the house and shine in bright red light to warn the house residents. In addition, the two buzzers would make a loud and continuous noise throughout the house until the gas in the air is cleared.

V. Application / Market Need

The device could be installed in the kitchen above the gas stoves. This device is especially useful as it could remind elderly people to switch off their gas immediately with a loud sound and bright red lights all over their house. It could ensure the safety of elderly people by alerting them so as to avoid accidents.

In the current market, there exists professional gas analyzers. However, they are usually expensive and are made for professionals to use. What makes our device irreplaceable is that our device is affordable, user-friendly, easy to use, and could provide multiple functions at the same time. It is tailor-made for elderly people in Hong Kong who may have weakened senses of smelling and hearing.

In the future, this device could be further developed to cover more aspects and a wider range of users, including elderly people with more difficulties, people outside home, etc.

VI. Conclusion

After building the circuit, installing the circuit onto the house model, and testing the device for many times, the device is always able to detect and respond as intended when exposed with the specific gas. By changing the gas sensor to the one for actual town gas, this device would be able to work correctly in flats and apartments in Hong Kong, to alert the elderly people in case of gas leakages and to prevent accidents.

Furthermore, the device is capable of being further developed. The microcontroller used in this device could be expanded or changed, so that more advanced technologies, like a WiFi module, could be incorporated.

Eventually, the device would be able to not only prevent accidents of gas leakage, but also protect lives of innocent people, and to raise public awareness of safety of vulnerable people in the society.

Our project is developed based on our school's previous project and the enhancement is as below: