

Design of an auto disconnecting regulator and a safety switch to prevent domestic gas leakages

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Abstract: There is a growing demand for research in various aspects of smart homes. Automated security systems are an integral part of smart homes. Liquid Petroleum Gas (LPG) is one of the popular fuels used in domestic cooking. Therefore, there is a very high demand for LPG fire security systems. In this study, an automated LPG fire security system for domestic gas leakages has been designed and a prototype model is constructed. The designed system automatically takes preventive measures in case of gas leakage. It includes a newly designed automatically disconnecting regulator from the cylinder which shuts OFF gas supply from commercially available gas cylinders, a control circuit for switching OFF the power supply of nearby area of gas leakage and transceiver unit for sending SMS to the corresponding people. It has been designed to operate automatically when LPG concentration reaches to 200 PPM, a value well below the LPG gas inflammable concentration. LPG concentration is sensed by the MQ-5 gas sensor and fed into the microcontroller. The commercially available gas regulator is modified by attaching a spring and solenoid valve. The spring is compressed when the regulator is ON. Once an LPG leakage of appropriate PPM is detected, a pulse is sent to the solenoid valve such that the attached spring gets rest by removing the regulator from the cylinder. At the same time, a warning message will automatically send to the corresponding users and security personnel through a GSM module attached to the circuit. The circuit is embedded with a rechargeable battery to work even in power outage. Additional gas sensors are installed in electrical switches located near to the gas cylinder and kept in connection with the microcontroller through the Bluetooth module to cut-off electrical power to prevent any spark.

Keywords: Bluetooth, Gas sensor, GSM, IoT, Smart home, Solenoid

I. INTRODUCTION

Smart City and Smart Home are among the emerging concepts in modern society. They appear as the next stage of recent trends in the urbanization of all around the globe [1]. While moving towards the knowledge-based economy, smart cities augment physical and digital infrastructure for urban development. A smart home is an integral part of the smart city and is going to be the promising future of high-quality living standards for the increasing urban population in the world [2]. An automated security system comes on top of

many aspects of the smart home. The main objective of such a system is to secure the home from fire and trespass. For this purpose, wireless sensors increasingly embedded in smart home security systems. In this study, a novel gas-fire security system has been designed for domestic usage. A prototype model of the proposed system is constructed and tested successfully.

Liquefied Petroleum Gas (LPG) is a highly inflammable gas made up of the mixture of propane and butane, with butylene, propylene and other hydrocarbons in small quantities. LPG is used as fuel for domestic, automotive and industrial purposes, including several heating applications such as metal cutting, welding, etc. However, it has gained considerable popularity in domestic usage as a fuel for cooking. Therefore, LPG fire security is an essential part of modern homes due to the increased use of LPG in daily life. Ethanethiol is added as a powerful odorant to give its characteristic smell since LPG is odourless so that when there is gas leakage it can be detected through smell. It is very important to detect LPG leakage as early as possible because of its highly flammable nature. If it is left undetected it can lead to a fire outbreak, causing severe injuries, loss of assets and sometimes death.

Several factors can be led to gas leakages, such as the carelessness of the user or the person who refills or service the gas cylinder/burner, faulty hose, and gas cylinder. Gas leakage as a result of a faulty cylinder is very rare because the cylinder can last more than two decades before it expires. LPG fire accidents are most commonly happen early in the morning. Electrical sparks inside the electrical switches are one of the main reasons for domestic gas fire accidents. If an LPG leakage lasts for a considerable period, it will eventually increase LPG concentration in the air. When it exceeds the harmful level, there is a high probability for a gas fire due to a spark caused by the switching ON an electrical switch of the nearby area. This happens as a result of a lack of sensory impairment on a person who awakened from sleep or person who didn't sense the smell of the LPG gas, unknowingly ON the electrical switch [3]-[4]. Therefore, this kind of gas fire accidents is most commonly happens early in the morning [5].