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LPG LEAKAGE DETECTION SYSTEM USING PHONE CALLS ALERTS TO PREVENT ACCIDENTS AND AVOID INJURIES

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ABSTRACT

This paper presents a system to improve the security of houses and properties that uses LPG gas. Given its flammability, an alarm system is strongly advised. To solve this issue, we house owner in a matter of seconds, at the beginning of a gas leak. Our system deals with limitations on Internet connectivity, using a clever solution to this problem.

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INTRODUCTION

Liquefied petroleum gas - LPG, popularly known as cooking gas, is present in 95% of Brazilian households, according to IBGE data (IBGE, 2011). Gas cylinders are considered the best means of gas storage and transportation, as in many environments, commercial, industrial and domestic, a small leak can create an irreparable disaster. Historically, LPG was produced at the Riverside Oil Co. refinery in the United States, and on December 24, 1910, 200 gallons of LPG were produced, (Sindigás, 1990). In 2017, according to Sindigás report, (Sindigás, 2018), around 7,389 million tons of gas were sold in standard 13kg cylinders for domestic use. This paper presents a system for automatic gas leak detection, with IoT alert. Adherence to low cost monitoring technologies has been growing year by year, the possibilities of implementing monitoring and alerting systems using IoT are endless, therefore, allied to the low cost of development and production, there are numerous possibilities of association.

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from sensors to low cost home, commercial or even industrial sensors. Currently there are commercially available in the market several ways to detect gas leakage through sensors, this work describes the development and application of a gas leakage detection technique to improve the method already used in the market. On the subject, the work of (Santos, 2012) uses a limited solution only with message sending (SMS) feature, other solutions have been found for commercial use.

LPG Composition

LPG is basically composed by propane and butane, with some small amounts of propylene and butylene (Sindigás, 2018). All these substances are in gaseous form in room temperature. In it's liquefied form present in gas cylinders can have a pressure between 3 to 15 kgf/cm2. For safety these gases are mixed with Thiol, adding odor and making it detectable by humans. With this composition, and evaluating the gas sensors available on the market, was chosen the MQ-6 sensor, the sensibility was established on 180 ppm (parts per million).

Occurrent Statistics: According to a study by (PROPOSTA DE PADRONIZAÇÃO NO ATENDIMENTO ÀS OCORRÊNCIAS ENVOLVENDO GLP, 2015), it is observed that there was a considerable growth in the total number of hazardous product incidents between 2011 and 2014. Within this growth, there was an increase in incidents involving LPG, from 68 calls in 2011 to 215 in 2014. Among the LPG occurrences, we highlight the evolution of attendance to occurrences with P-13, highlighting the importance of developing automatic mechanisms for detection and warning of LP gas leakage.

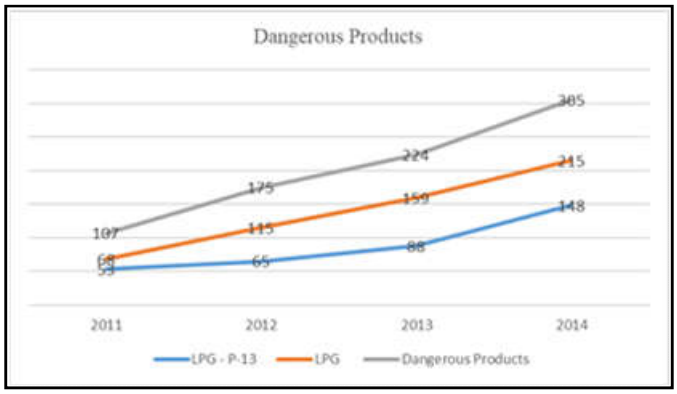


Figure 1. Evolution of event handling involving GLP-P13 in Goiás. Source: SIAE/COB, adapted by [6]

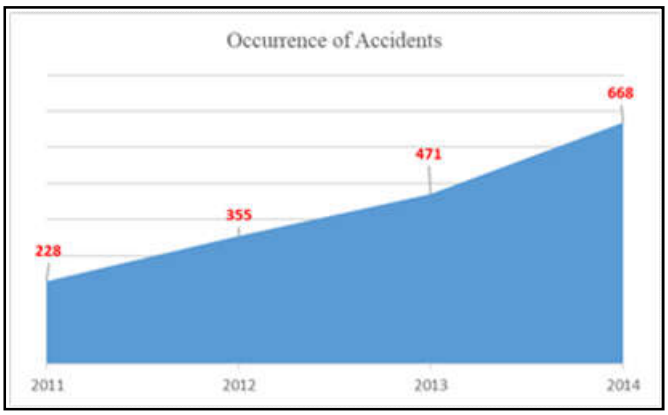


Figure 2. Accumulated, 2011-2014

Internet connectivity limitations: Due to lacks on Internet connection limitations in Brazil, and to make the device broadly available, we decided to use GSM phone services to improve availability and reliability. Internet is becoming more available, but its stability stills an issue in many places. Similar systems send SMS messages (Santos, 2012), or uses XBee radios (Sobrinho, 2014) to solve the same issue.

Objectives

Introduce a low-cost, IoT-based gas leak detection technique using the Arduino UNO module in conjunction with the SIM900 module and the high-sensitivity GLP, Isobutane, and Propane MQ-6 gas sensor.

MATERIALS AND METHODS

In this session we will present the materials and methods used for the development of the automatic phone call alert gas leak detector. As well as the procedures performed in the development of the research. The material is listed below and the procedures are described in the following items. We used an Arduino UNO R3 card, a *SimCom* GSM SIM900 module with a 2A power supply, an MQ-6 GLP gas sensor module, already soldered on the interface board, a 9V, 2A for the GSM module, a protoboard for prototyping and Arduino's own development interface, which is available at: http://arduino.cc/ and a GSM chip.

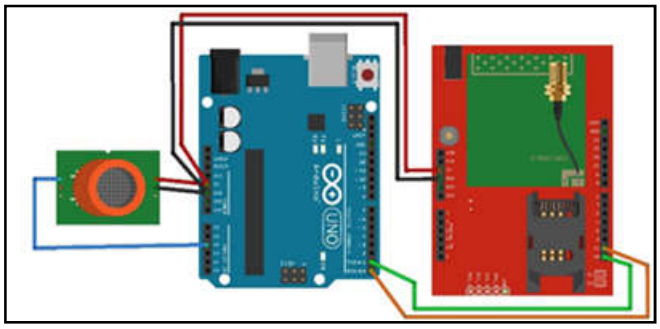


Figure 3. Prototype schematic diagram

Arduino UNO R3: The Arduino UNO R3 shown in (Figure 3), [7] is a free and open source low cost embedded systems development platform.

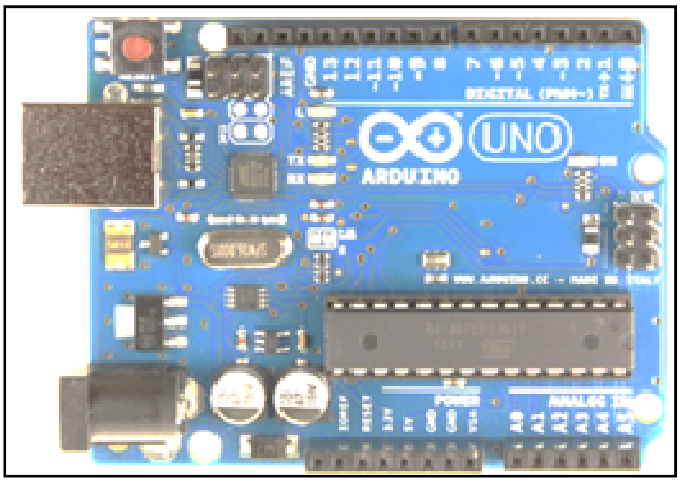


Figure 1. Arduino UNO R3

The definition given by [8] is that Arduino is a single-board microcontroller designed to make the process of using electronics in multidisciplinary projects more affordable. The hardware consists of an ATMEL ATMEGA328-P PV microcontroller, an 8-bit device from the AVR family with advanced RISC architecture and DIP28 encapsulation, has 32KB of Flash, being 512Bytes for the *bootloader*, having a low power consumption.

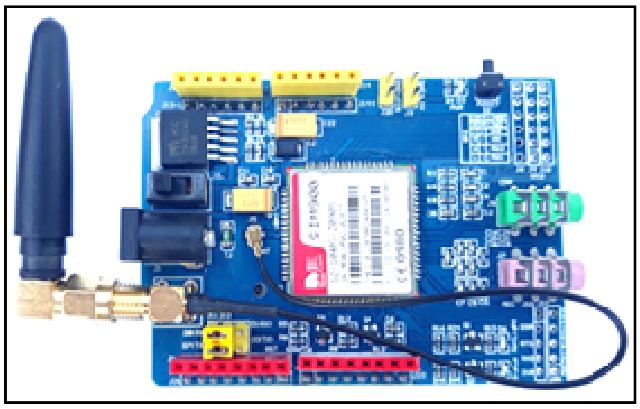
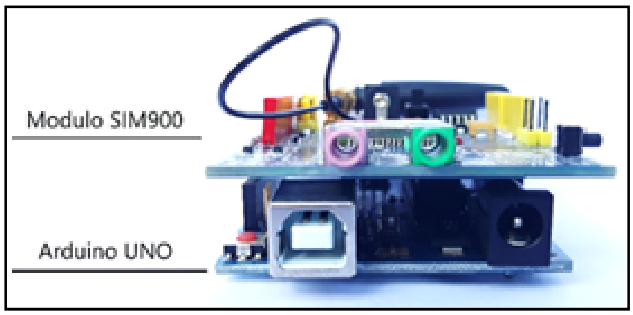


Figure 2. Module - GSM/GPRS SIM900

Module GSM/GPRS SIM900: SimCom's GSM / GPRS SIM900 module (Figure 5) has GSM and GPRS technology, with which you can make calls, send and receive text messages and even use the internet from a mobile phone chip, with all these features. functions coupled to an Arduino microcontroller; we can get various functionality.



MQ-6 LPG GAS SENSOR: The MQ-6 GLP gas sensor (Figure 7) can be interconnected with microcontrollers such as Arduino, PIC or boards such as Raspberry Pi to create alarm and gas monitoring systems by triggering microcontroller ports for actions such as actuator actuation or combined with other alert modules via automatic connection.

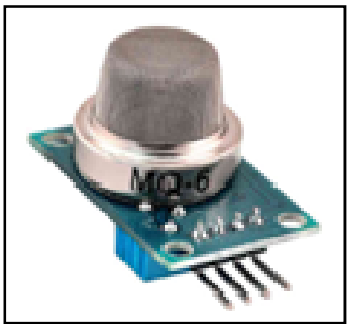


Figure 7. LPG Gas Sensor Module

There are a wide variety of gas sensors, among them we have the MQ's. These modern, low-cost gas detection sensors monitor in real time and can be used with Arduino and other microcontrollers.

Systems Development: To make a prototype we made use of development boards that could lead to a final product with an accessible price. This requisite led our work to ATMega based boards (Arduino) [8] [9], given its reliability, robustness, and low price. Another choice was the SIM900 GSM Module, that has a complete cell phone that can make calls, send messages and even connect to the Internet.With the already given gas sensor, we could build the alarm system as shown on Figure 1. The wiring mapping can be checked on Table 2 and Table 3.

Sensor MQ-6	Arduino UNO
A0	A2
D0	Desligado
GND	GND
VCC	5V

Figure 8. Arduino Pinout Mapping

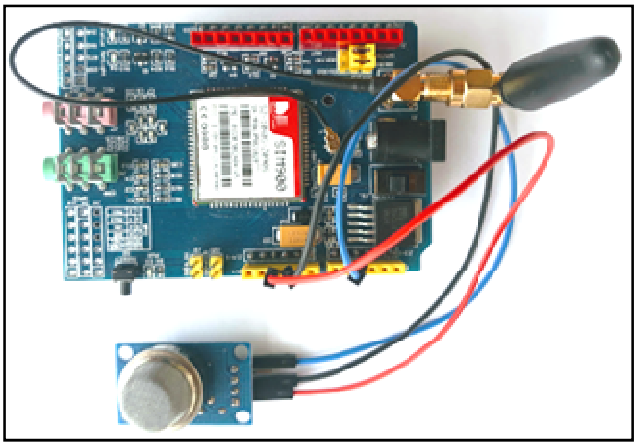


Figure 3. Prototype

Testing Procedures: Compressed gas is extremely flammable, with a risk of explosion indoors, as 1 kg LPG equals 0.98% TNT, [10]. The mixture is heavier than air and can travel a considerable distance to an ignition source. For better safety in the test environment a glass container was used over the gas outlet of a stove, leaving the gas sensor near the gas outlet for testing as shown in (Figure 10).

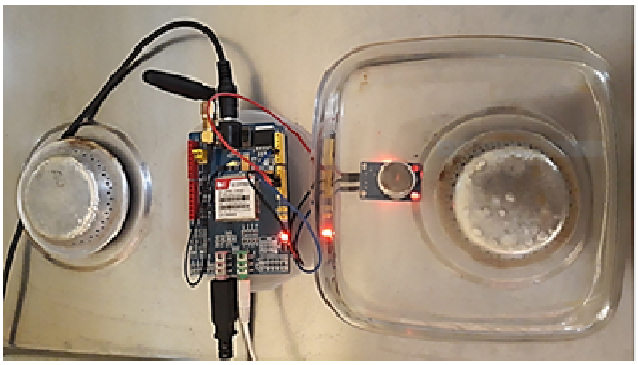


Figure 4. Testing the system

An audible alarm works with people close to the alarm, but when they are away from a problem it appears, it is the late discovery of a leak that leads to accidents. SMS messages can be ignored and cannot be delivered on time. With a proper call, people can react faster by using the appropriate measures to avoid a bigger problem. In other works, we hope that it will not only call, but make it a device connected to the Internet. We already have the hardware, but we must circumvent the limitations imposed due to the lack of connectivity mentioned above. In (Figure 12), we can see the system flowchart, when the system is turned on, it is analyzing the air, if you pass the LPG through the MQ-6 sensor, a call is made to the registered phone in order to warn about the leakage of gas for quick decision making.

RESULTSAND DISCUSSION

Initially, to simulate the operation of the sensor was used a lighter simulating the gas leak in the open environment, obtaining the real time reading, the answers were very accurate, however, the module only made a connection, since the gas was it dissipated into the air quickly. The source code has been changed several times to define the level of gas that would be checked before the alert. We initially tested with very high values, triggering the alert with 180ppm (parts per million), performed 10 tests and got the following results:

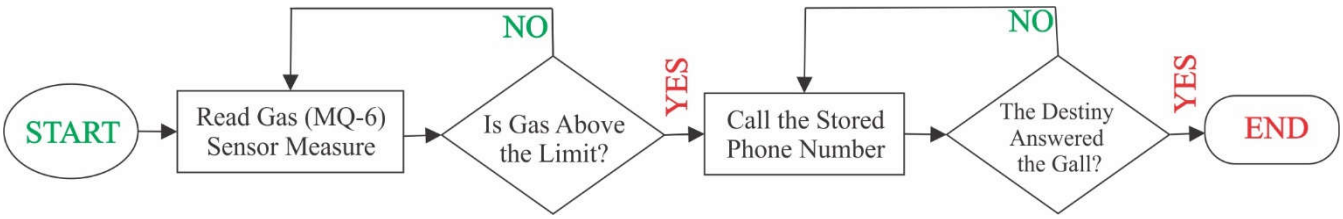


Figure 12. Flowchart with a simplified version of the program

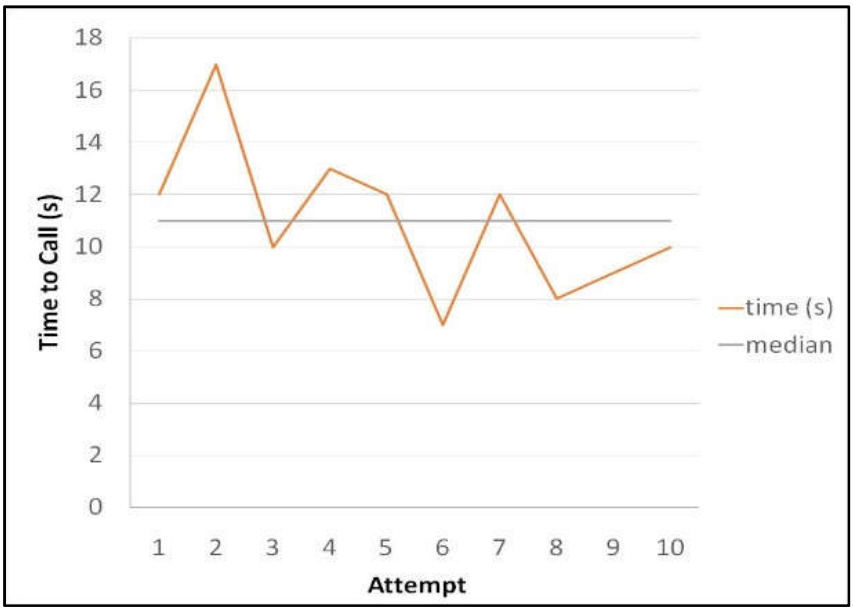


Figure 5. Allback time and time relationship

In the tests performed we obtained an average time of 11 seconds between gas detection by the sensor with the gas level configured to perform the call when it reached 180 ppm, then we made another 10 tests where we set the source code to 20 ppm and we got so the same result as graph 1. The reduction in the reading of the analog values in the program did not affect the alert trigger, coinciding in the same result, since what was sought was the efficiency of the GSM shield as an alert, with the average time continuing. In 11 seconds, we can infer that there is an efficient response to the proposed problem.

Conclusion

This article describes an alert system using phone calls, we couldachieve the desired result, with a fast, cheap and robust prototype. It can tackle a problem that similar systems have. A sound alarm works with people nearby the alarm but when they are away from an issue appears, that is the late discovery of a leak, leading to accidents. SMS messages can be ignored and may not be delivered in proper time. With a proper call, people can react more quickly, using the proper measures to avoid a bigger problem. In further works, we expect to have it not only calling but making it an Internet-connected device. We already have the hardware, but we must circumvent the limitations imposed due to the lack of connectivity before mentioned.

REFERENCES

IBGE, “Instituto Brasileiro de Geografia e Estatística. Pesquisa de OrçamentosFamiliares 2008-2009”, IBGE, Rio de Janeiro, Análise do ConsumoAlimentarPessoal no Brasil, 2011.

Sindigás, *Ospioneiros do GLP: meioséculo de história*, 2º ed. São Paulo: CâmaraBrasileira de Livro, 1990.

Sindigás, “PANORAMA DO SETOR DE GLP EM MOVIMENTO”, São Paulo, Relatório Técnico, abr. 2018.

Santos, J. S. “Detector de vazamento de gás com aviso por sms”, 2012.

Sobrinho, F. V. “Segurança com gásliquefeito de petróleo - GLP”, apresentadoemFunda Centro, São Paulo, 2014.

“PROPOSTA DE PADRONIZAÇÃO NO ATENDIMENTO ÀS OCORRÊNCIAS ENVOLVENDO GLP (P-13)”, ABMGO - Academia de BombeiroMilitar de Goiás, Goiânia-GO, 2015.

Oliveira, S. *Internet das Coisas com ESP8266, Arduino e Raspberry PI*. São Paulo: Novatec, 2017.

Roberts, M. *Arduino Básico*, 2º ed. Novatec, 2015.

Air Liquide Brasil LTDA, “Mistura de Gases Inflamáveis (Propano e Butano)”. 2010.

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