IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Gas Leakage Detection And Localisation In Automobile AC

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Abstract

Gas leaks can cause major incidents resulting in both human injuries and financial losses. To avoid such situations, a considerable amount of effort has been devoted to the development of reliable techniques for detecting gas leakage. As knowing about the existence of a leak is not always enough to launch a corrective action, some of the leak detection techniques were designed to allow the possibility of locating the leak. The main purpose of this paper is to identify excellent method in leak detection and localization. The proposed work is mechanical based automatic-locking and sensor based detection system which helps to identify failure of parts during leakage. Similarly study also helps to evaluate the capabilities of these techniques in order to identify the advantages and disadvantages of leak detection solution.

1. Introduction:

The worldwide natural gas transport and distribution network is a complex and continuously expanding one. It is found that (TRB, 2004), pipelines, as a means of transport, are the safest but this does not mean they are risk-free. Therefore, assuring the reliability of the gas pipeline infrastructure has become a critical need for the energy sector. The main threat considered, when looking for means of providing the reliability of the pipeline network, is the occurrence of leaks.

Regardless of their size, pipeline leaks are a major concern due to the considerable effects that they might have. These effects extend beyond the costs involved by downtime and repair expenses, and can include human injuries as well as environmental disasters. The main causes of gas pipeline accidents are (EGIG, 2008): external interference, corrosion, construction defects, material failure and ground movement.

To counteract the disastrous effects of gas leaks, considerable effort has been invested, during the last decades, in designing gas leak detection techniques. However, revealing the presence of a gas leak is not sufficient in order to define an efficient counteracting measure. Before deciding on a set of corrective actions, other information has to be known such as: the location of the leak, its size, etc. These subjects were also in the focus of research done in the field of pipeline reliability assurance.

The occurrence of gas leak-related incidents was studied by several organizations which published statistics on the reported incidents. One of these studies, made on the sub-sea pipeline systems (SLR, 2009), states that, between 1996 and 2006, a number of 80 pipeline rupture incidents were reported in the Gulf of Mexico and Pacific areas. Based on data gathered in this report, the calculated probability of a catastrophic incident, for the specified area, is 0.43 incidents per year. Another survey (Konersmann, Kühl, & Jörg, 2009), which focuses on the risks of pipeline transportation, covers incidents that occurred in Europe and on the American continent presenting the main causes of pipeline failure. According to this report, in the province of Alberta/Canada alone, there have been 1326 reported gas leaks in the 2001–2005 period. A different report

shows that large pipelines (i.e. with a length of 800 miles or more) can expect at least one reportable leak-related incident per year (ADEC, 1999). This evidence indicates that the risk of incidents caused by gas leaks is substantial despite the great variety of leak detection methods available and serves as motivation of our work.

The main purpose of this paper is to identify the state-of-the-art in gas leak detection techniques and to present localizing capabilities, as well as other important features, for each of the studied methods. We achieve this by performing an extensive survey of the literature in the field, covering results from academia as well as industry reports.

A number of reviews on the subject of gas leak detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects (Batzias, Siontorou, & Spanidis, 2011; Folga, 2007; Liu, Yao, Gallaher, Coburn, & Fernandez, 2008; Matos, Powell, Davies, Zhang, & Moore, 2006; Zhang, 1997) or as a result of research dedicated to this specific purpose (ADEC, 1999; El-Shiekh, 2010; Geiger, Werner, & Matko, 2003; Jolly, Morrow, O'Brien, & Service U.S.M.M, 1992; Loth, Morris, & Palmer, 2003; Scott & Barrufet, 2003; Sivathanu, 2003; Stafford & Williams, 1996; Turkowski, Bratek, & Słowikowski, 2007; USDT, 2007; Wang, Lambert, Simpson, & Vitkovsky, 2001). Although they provide a good overview on existent leak detection techniques, these surveys are either succinct, omitting several leak detection methods or, in some cases, not of a recent date.

In order to decide which leak detection technique is more suitable for a given setting, a comparative performance analysis is necessary. For this we compare the studied methods by a set of common features using performance reports from literature. As a conclusion, and apparently future trend, a hybrid approach combining different detection methods to achieve the required system performance would be the best choice.

2. Construction and Working of Developed model:

Number of systems are proposed and implemented to resolve the problem of identifying and rectifying the gas leakages. Some of the systems have identified by different ways like DC motors, micro-controller, etc. By the observations made, we still feel that the system existing can still be improved for detection and provide better solutions without using electronic device helps for notification because they may also catch up with the fire accidents.

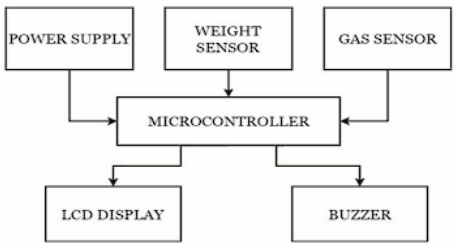


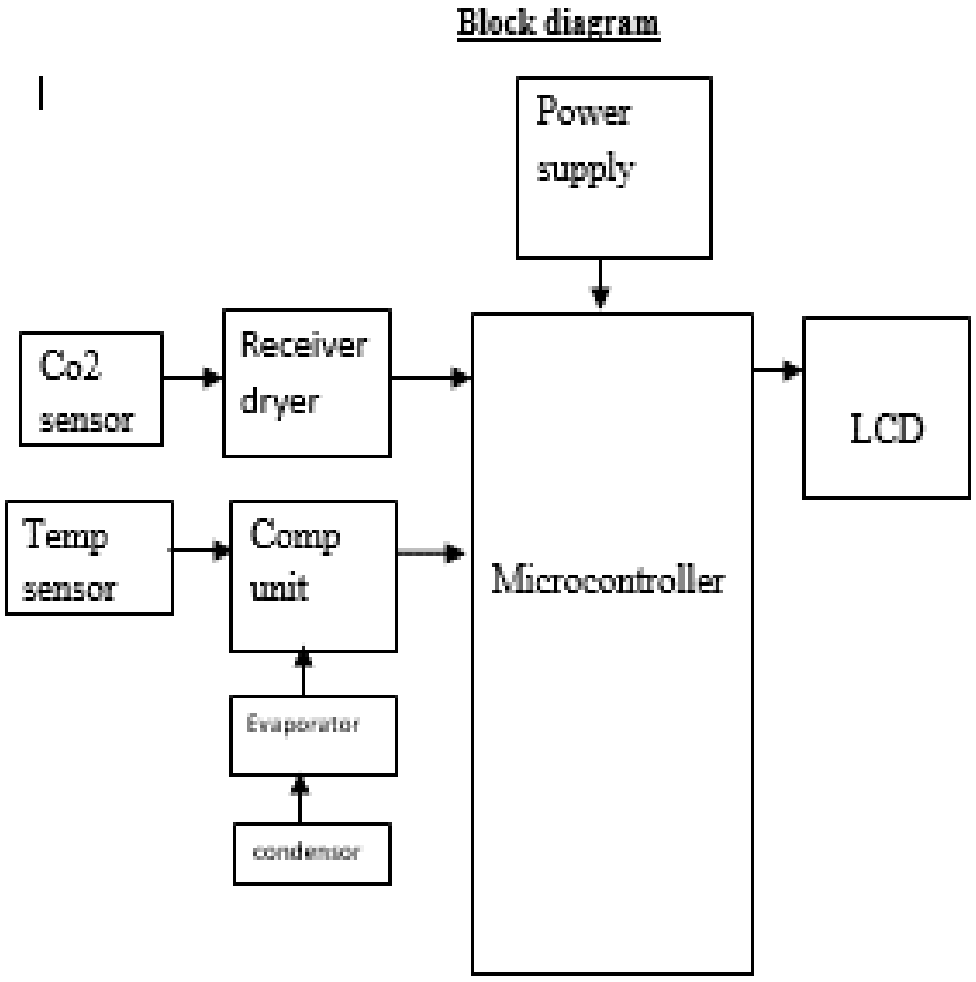
Figure 1: One among the existing System From the existing system

If a failure arrives for providing a solution after detecting a gas leakage of one of a components, then it will be a complete failure. To overcome this the research work proposes a mechanical based automatic-locking and sensor based detection system (existing) during leakage instead of electronic based existing system. All the existing systems identify and inform the same to the user in the form of SMS, or an alert through buzzer, etc. but due to the signal transmission happens using electro-magnetic waves then there can also be chance of catching up with the fire due to the closed area where there is no outlets opened for Gas to escape. Hence in our proposed system we have planned to implement the detection and prevention system integrated in such a way that there will be a scenario where preventions is defined by a mechanical method that will close the gas cylinder's valve automatically when the threshold of the gas leakage measured to be more than the normal

(increasing). In our system the advantage factor is that there is an inclusion of mechanical PULLY system that will be initiated by the valve that closes the cylinder's mouth to stop releasing the gas, immediately to open the window pane automatically along with an exhaust fan turning on. Hence, we may prove that when there is no chance of electricity, electro-magnetic waves or fire involvement during a leakage of gas then there may be no chance of catching of fire

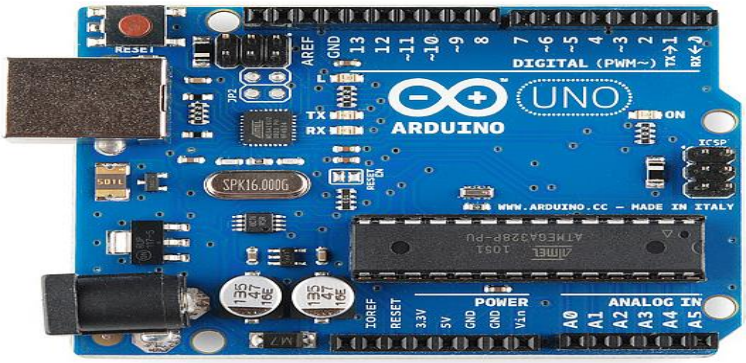
The various parts used in this model are discussed in subsequent section.

The working model of the research work is as shown in figure 2.



3.1 Arduino :

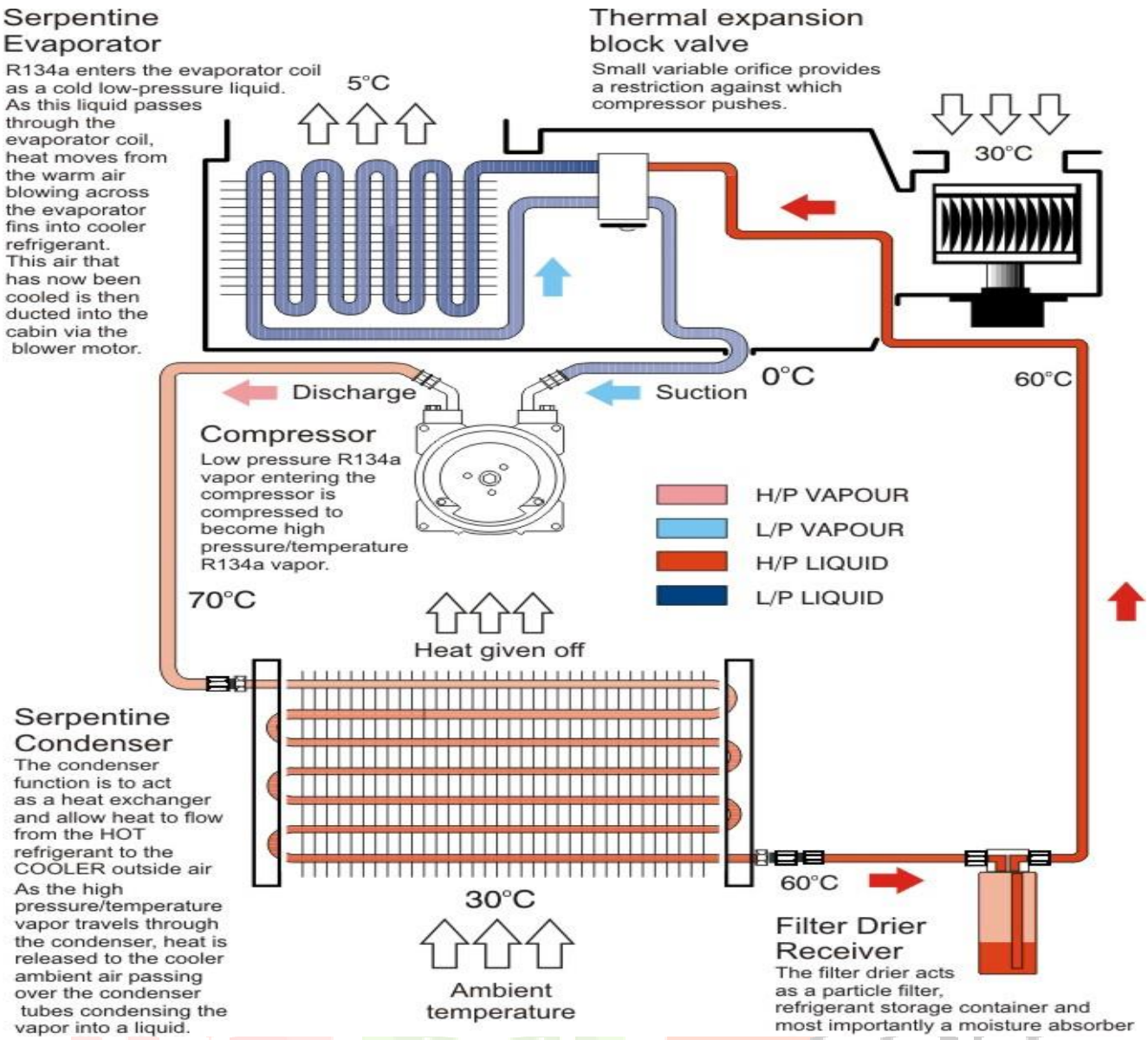
Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.



The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

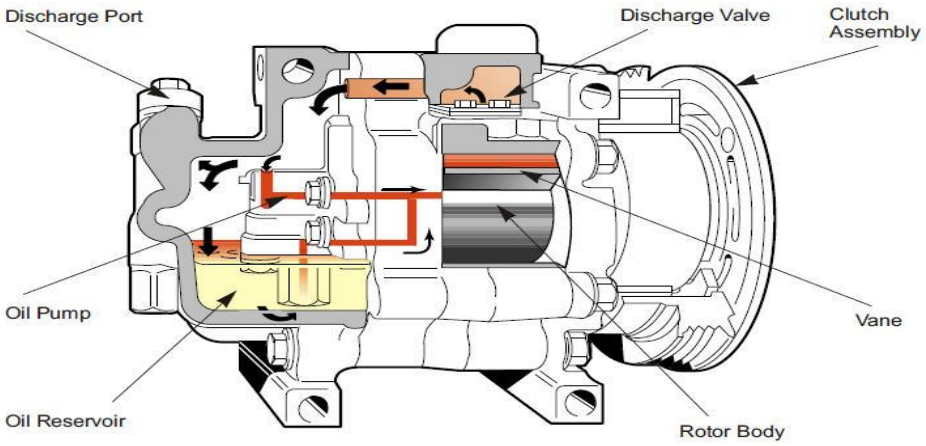
2.2 LCD Display : LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).

2.3 Resistance Temperature Detector : The RTD is a temperature sensing device whose resistance changes with temperature. Typically built from platinum, though devices made from nickel or copper are not uncommon, RTDs can take many different shapes (figure 1). To measure the resistance across an RTD, apply a constant current, measure the resulting voltage, and determine the RTD resistance. We then use a resistance vs. temperature plot to determine the temperature of the surrounding medium (figure 2). RTDs exhibit fairly linear resistance to temperature curves over their operating regions, and any nonlinearities are highly predictable and repeatable.


Serpentine Evaporator
R134a enters the evaporator coil as a cold low-pressure liquid. As this liquid passes through the evaporator coil, heat moves from the warm air blowing across the evaporator fins into cooler refrigerant. This air that has now been cooled is then ducted into the cabin via the blower motor.
5°C
Thermal expansion block valve
Small variable orifice provides a restriction against which compressor pushes.
30°C
0°C
60°C
Discharge
Suction
Compressor
Low pressure R134a vapor entering the compressor is compressed to become high pressure/temperature R134a vapor.
H/P VAPOUR
L/P VAPOUR
H/P LIQUID
L/P LIQUID
70°C
Heat given off
Serpentine Condenser
The condenser function is to act as a heat exchanger and allow heat to flow from the HOT refrigerant to the COOLER outside air
As the high pressure/temperature vapor travels through the condenser, heat is released to the cooler ambient air passing over the condenser tubes condensing the vapor into a liquid.
30°C
Ambient temperature
60°C
Filter Drier Receiver
The filter drier acts as a particle filter, refrigerant storage container and most importantly a moisture absorber

2.4 A/C System with : Therma Expansion Block valve, serpentine Condenser, Serpentine Evaporator

2.5 Compressors: This compressor uses a unique design with two scrolls, one fixed and one is movable, both are inter-leaved. The movable spiral is able to ORBIT or oscillate without actually fully rotating. The movable scroll is connected to the input shaft via a concentric bearing. As the movable spiral oscillates within the fixed spiral, a number of pockets are formed between the spiral. As these pockets decrease in size the refrigerant is squeezed, the pressure increases and is discharged through a reed valve at the discharge port in the rear section of the compressor.



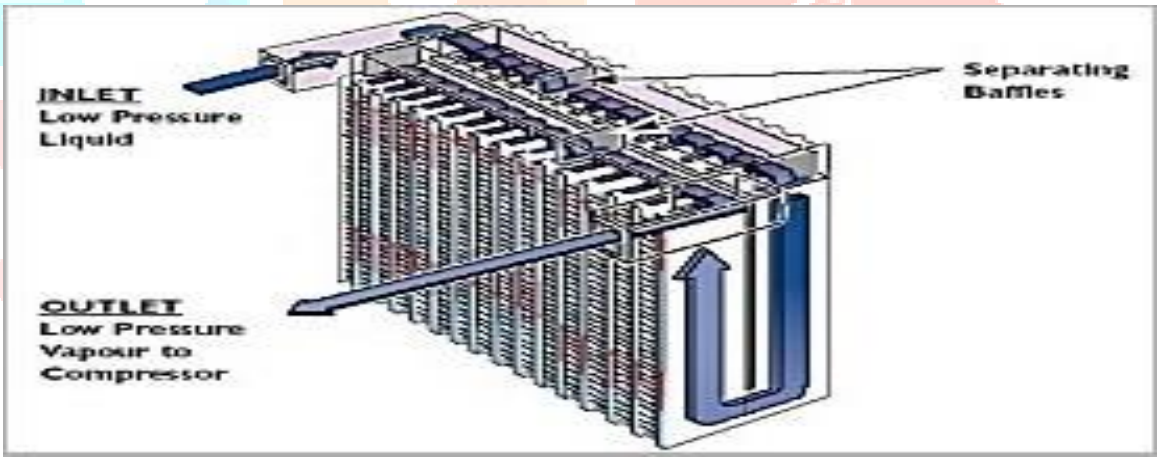
2.6 Condensers: The Condenser function is to act as a heat exchanger and allow heat to flow from the hot refrigerant to the cooler outside air. R134a entering the condenser will be a high-pressure high temperature vapor. As the R134a vapor travels through the tubes of the condenser heat is given off to the cooler ambient air; the refrigerant vapor condenses and changes to a liquid state. At this point a large amount of heat is given off by the R134a. The refrigerant will now be a hot, high-pressure liquid.

2.7 Condenser electric fan

Most vehicles with air conditioning require an electric fan to assist air flow, either pushing or pulling the air through the condenser, depending on which side of the condenser the fan is placed. The majority of vehicles using R134a require this additional condenser cooling due to the higher operating pressures of R134a. Also most modern vehicles now have smaller grilles or bumper bar openings. This causes poor air flow conditions especially by the amount of air flow over the condenser. The condenser fan is operated with A/C engaged in various ways:

2.8 Serpentine evaporator

Same design as the serpentine condenser but approximately five times deeper.



2.9 Accumulator (Orifice Tube System)

The function of the accumulator is to store refrigerant, filter particles, absorb moisture and separate vaporous R134a from liquid R134a. The normal process of the Orifice Tube system works when R134a leaves the evaporator coil as a mixture of vapor and liquid. This liquid enters the accumulator and falls to the bottom. The vapor rises to the top and continues onto compressor. The liquid R134a in the bottom of the accumulator gradually vaporizes off. This vapor rises, then pulls into the compressor.

3. APPLICATIONS

The developed system is applicable in following areas

- Gas leak detection system
- Fire/Safety detection system
- Gas leak alarm
- Gas detector

4. Conclusion:

This system helps you to upgrade your safety standards, comply statutory requirements on environmental commitments and most important and basic function being prevent accidents and protect life and property from disaster. In the past, it has been a conventional practice to employ combustion apparatus such as a furnace, heater, stove or LPG kit in cars, which utilizes a combustible vapor or gas to produce heat energy when properly ignited. In the use of combustible apparatus in which a combustible gas such as natural or liquid propane gas is burned in heating boilers, domestic water heaters, ovens, stoves and the like, the apparatus or appliance is generally of an automatic recycling type. That is to say, the equipment is generally in operation for short periods of time after which is shut down for a short period of time. The equipment has intermediate operation and the appliance is generally started and stopped at the signal of an automatic controller, such as a thermostat, which may be actuated by temperature, pressure, or the like. The LPG Kit installed is many times installed inside the car creating possibilities of large accidents. This type of appliance/Kits is normally unattended by any operating personnel, since it is automatic in operation and, therefore, one hazard encountered in the use of such an appliance is the possibility that during a standby period or a period in which it is not in operation, a gas leak may occur thereby resulting in a large accumulation of combustible gas which can produce an explosion if the detection is not quickly noticed. Although some sophisticated detector means have been provided, it is contemplated that the indicator means should be simple and economical so that the entire system may be readily incorporated into mobile trailers, campers, boats and other vehicles or living quarters having appliances dependent upon storage of pressurized gas.

5. Future Scope:

The proposed system shows high sensitivity to LPG, iso-butane, propane as well as small sensitivity to alcohol, smoke. Similarly it has fast response and wide detection range hence the proposed system is planned for implementation in all areas like vehicles such as car, auto, etc. and kitchen areas for accuracy and efficiency measurements

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