

Multi-Criteria Fire Alarm (McfA)

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The State of Today's Low Cost Fire Detectors

- **A \$10 ionization smoke detector is notoriously**
 - *False-alarm prone**
 - *Radioactive (Americium 241 half-life 500 years)**
 - *Slow to flaming fires producing little or no smoke**
- **A \$35 photoelectric smoke detector is better but is still**
 - *False-alarm prone**
 - *Slow to flaming fires**
- **False alarms have grown to be a very serious problem over the years in many cities and towns all over the world occupying far more productive time for fire fighters and police personnel**

False alarm ordinance watch

ANKENY, IOWA

Fire Chief David Burns told the City Council that November, 2004's false fire alarm ordinance isn't doing the job, reported The Des Moines Register.

False alarms have increased 30 percent this year, he said. Burns couldn't estimate a cost related to false alarms for the council, but he did say that open calls, where there is no report of smoke or fire, will

now only be handled by on-duty staff. On-call staff will not respond.

HAYWARD, CALIF.

Hayward police Chief Lloyd Lowe said that last year's estimated \$468,000 spent on false alarm calls means that the

city's false alarm ordinance in need of an update, reported The Daily Review.

Lowe said that 1,659 of 1,678 residential alarm calls, or 99 percent, were false last year. Currently, the city imposes a \$50 fine on a user's second false alarm, \$100 for a third and \$150 for a fourth and any further false alarms in a six-month period.

That's too little, said Lowe, who was quoted as saying, "It's cheaper for them to pay our bills than to have the company come out and fix the alarms." However, one councilman said the city was not interested in having police officers only respond to verified burglar alarms. The council will likely consider a proposal to increase fines in the coming months.

PASADENA, TEXAS

An ordinance enacted Oct. 18 now requires that fire alarm systems monitored by third-party monitoring companies be permitted every two years, reported The Pasadena Citizen. Healthcare facilities must have their fire alarm systems permitted every year.

By April 30, 2006, systems must be permitted or be subject to between \$75 and \$2,000 in fines for each day they are in violation. Permitting fees are \$10 for a home, \$24 for a business, and \$125 for a healthcare facility.

The ordinance goes further to penalize for false alarms. The third and fourth false alarms in a year will incur a fine of \$100, five through 10 will result in \$200 fines and any false alarm after that will cost \$500.

PRINCETON, N.J.

The Princeton Township Committee passed, on Oct. 24, a new ordinance that requires any user who experiences more than one false alarm within any one-year period to add to their system a mandatory audible 15-second signal, designed to prevent accidental activation.

Also, there is a minimum penalty of \$200 for the second false alarm in a one-year period, \$300 for the third, on up to \$500 each for five or more false alarms.

After the fifth false alarm, users will be required to implement a corrective action plan to prevent additional false alarms, which must be approved by the police and fire departments.

Ten false alarms in a year will require the user to disconnect the alarm system for the rest of the year or 90

days, whichever is longer, and reimburse the fire or police department for responding to the alarms. Schools, banks and hospitals will be allowed to keep the alarm system, but will still have to pay the reimbursement. SSM

From: Tom Campbell <tcampbell@airware-inc.com>

To: jacobwong@airware-inc.com <jacobwong@airware-inc.com>

Date: Thursday, November 17, 2005 8:11 PM

Subject: Siemens' technology

Dear Jake:

New article on technology from Siemens:

Smart fire detector could slash false alarms

. 14:10 25 October 2005 NewScientist.com news service Kurt Kleiner

A fire detector that can tell the difference between burning toast and a burning building could save money, annoyance, and possibly even lives, by cutting down on false alarms.

German company Siemens will start selling the detector in the UK to commercial users by January 2006, and the technology could eventually make its way into homes, says the firm's fire safety manager, Andrew Morgan.

The detector uses four sensors and a neural network to determine if the smoke and heat it's detecting are from a fire or are just part of the normal room environment.

In the UK more than half of the 872,000 fire call-outs in 2004 were bogus, and 285,000 of those false alarms were due to fire detectors. Responding to false alarms costs money, and in the home annoying false alarms encourage people to disable their alarms.

Built-in intelligence

Most home alarms are designed to go off when smoke in the air exceeds a certain concentration. But as most people have discovered, the detectors do not distinguish between smoke from frying bacon, steam from a hot shower, or fumes from a smouldering mattress.

A Most Puzzling Question...

- ***We could go to the moon, how come for decades we have not been able to make a better fire sensor than the smoke detector for the general public?***
- **A conspiracy theory:**
 - **Even poor families have to be protected from fire, so fire detector cannot cost more than just a few dollars each.**
 - **For the few market-dominating manufacturers... things are just fine...why spend any money doing research if we can make millions year after year selling just smoke detectors.**
- * **The real truth... Gas sensing technology is not ready until just a couple of years ago. If we have the resolve, now is the time to invest the resource to make it happen!**

Prerequisites for making a better fire sensor

- Understanding fire as a combustion process
- Understanding the pros and cons of various gas sensing technologies and utilizing them accordingly
- Taking full advantage of new regulation requiring families to protect themselves inside their homes from lethal CO thus giving more room for the selling price of a combined CO and fire sensor unit for the general public

The Basic Fire Process I

- Fire is an oxidation process.
- At the onset, incomplete combustion always occurs first for common fires, albeit the amount may vary, leading to the generation of smoke and CO in the beginning.
- The ensuing fire can soon be dominated by complete combustion with the subsequent generation of abundant amounts of CO₂ and H₂O at the expense of smoke and CO
- But variable amounts of smoke and small quantity of CO always precede most common fires.
- For engulfing fires, Lots of CO₂ are produced even right at the beginning.

The Basic Fire Process II

- **Smoldering fires accompanied by much smoke and deadly CO are more dangerous to humans than destruction of building structures by engulfing fires.**
- **Although smoke detectors are best for detecting smoldering fires, they are deficient in detecting flaming fires and CO. They are also false-alarm prone and could be radioactive (ionization types).**
- **CO sensors are also good for detecting smoldering fires. But until only very recently, detection of CO is limited by gas sensing technologies.**
- **CO₂ sensors are best for detecting engulfing fires. But detection of CO₂ while not limited by gas sensing technologies is limited by high unit cost, high power consumption and limited detection capability as a standalone fire alarm or even when deployed with smoke detectors.**

Taking Advantage of what the fire process has to offer

- **In addition to just detecting smoke from a fire, one must recognize the importance of detecting other gas byproducts from a fire.**
- **Of the three effluent gases generated by common fires, detection of CO and CO₂ along with smoke is particularly important and it provides a golden opportunity for realizing a better fire sensor than the smoke detector alone.**
- **The technological barrier for the detection of these two gases has recently been removed with an excellent prospect now for realizing a better fire sensor for the general public in the future.**

Removing gas sensing technological barrier I

- **Of the myriad of gas sensing technologies, only Electrochemical and Non-Dispersive Infrared (NDIR) gas sensors are good enough for detecting gas byproducts from fires.**
- **Today electrochemical CO sensor is good enough to be used in homes for protecting occupants from deadly CO accumulation with a minimum 7 years life. As for assisting the smoke detector as a fire alarm, its low ppm detection sensitivity, output stability over time and even longer operating life still face formidable challenges.**

Removing gas sensing technological barrier II

- **NDIR CO₂ sensors good enough to assist the smoke detector as a fire alarm have been available for over a decade except for their output stability over time.**
- **Recent technological breakthrough in the development of Absorption Biased (AB) designed NDIR gas sensors significantly eliminate output drifts over time.**
- **For the first time, NDIR gas sensors are now ready for use for detecting both CO and CO₂ from fires.**
- **For NDIR CO sensors, low ppm detection sensitivity and low unit cost still remain as major challenges.**

The Multi-Criteria Fire Alarm (Mcfa)

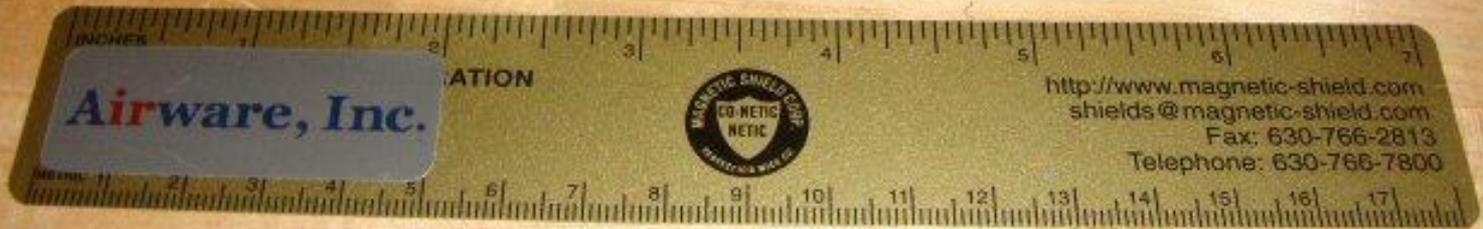
- **The recent breakthrough in NDIR gas sensing technology in the elimination of sensor output drifts over time has led to the concept of a much improved fire sensor called Mcfa.**
- **Mcfa is basically a multi-criteria fire alarm that combines the function of a smoke detector with an NDIR CO and NDIR CO₂ gas sensor in the detection of fire.**
- **In so doing, Mcfa is capable of eliminating all false alarms, providing faster speed of response to all types of fires, protection from deadly CO inside a household and automatic functional failure enunciation.**

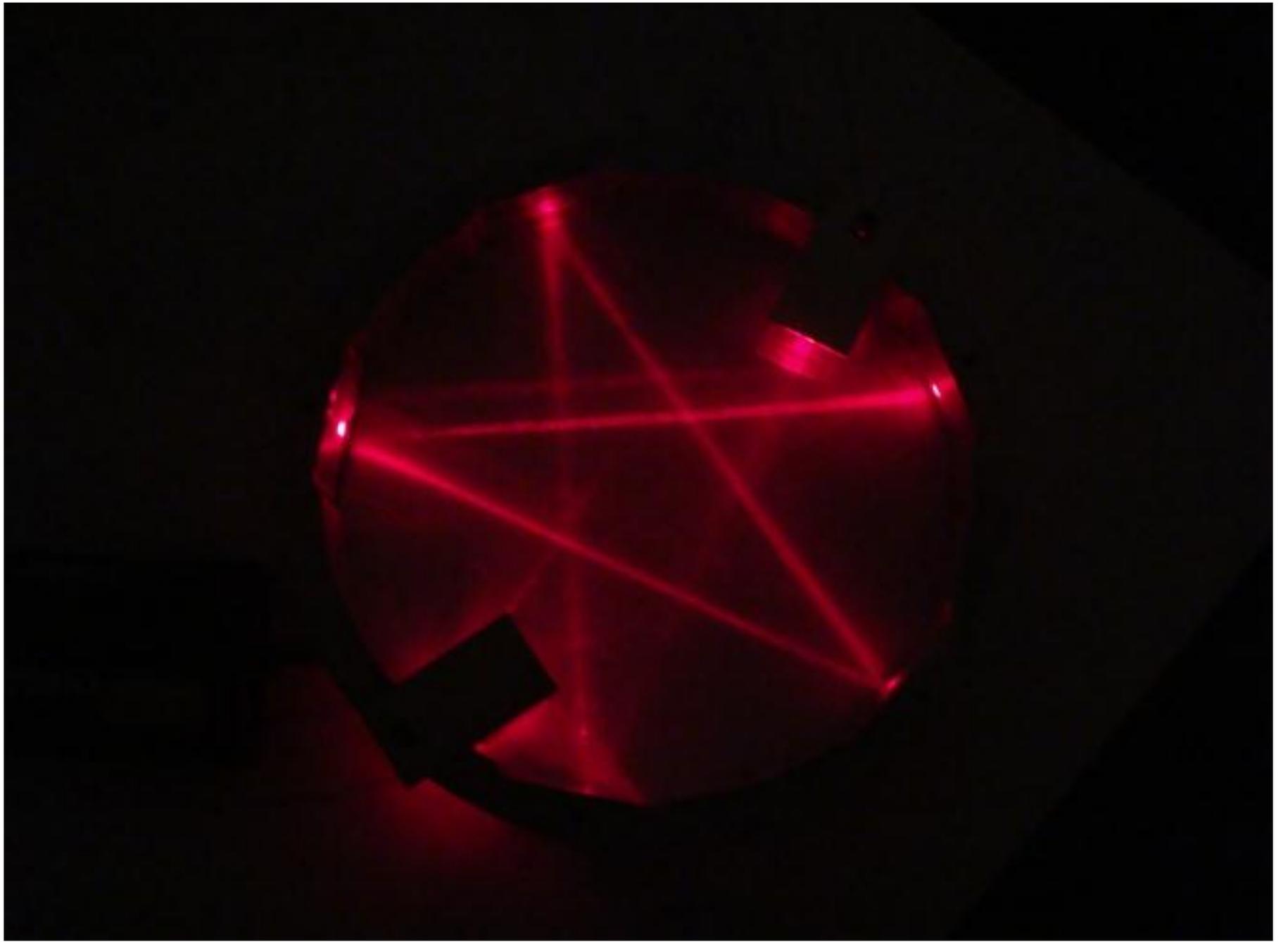
The Alarm logic components of Mcfa

- Alarm sounds if smoke detector exceeds $N\%$ /ft obscuration for greater than period T_1 .
- Alarm sounds if smoke detector exceeds $M\%$ /ft obscuration ($M < N$) for greater than period T_2
- Alarm sounds if 1) CO detector output $> R_1$ (X ppm/min) for greater than period T_3 AND 2) smoke detector exceeds $M\%$ /ft obscuration
- Alarm sounds if CO detector output $> R_2$ (Y ppm/min) for greater than period T_4
- Alarm sounds if 1) CO₂ detector output $> R_3$ (Z ppm/min) for greater than period T_5 AND 2) smoke detector exceeds $M\%$ /ft obscuration
- Alarm sounds if CO₂ detector output $> R_4$ (ZZ ppm/min) for greater than period T_6

Challenges for implementing Mcfa

- **Mcfa size – How to accommodate long sample cell path length (>24”) for NDIR CO detector**
- **Mcfa false alarm – Has to deal with interference of H₂O to NDIR CO detector – use NDIR H₂O sensor measuring H₂O concentration level for correction**
- **Mcfa unit cost – Since Mcfa is essentially a fire detector and a CO monitor combined, its unit cost can reflect the costs of two sensors in one.**





Summary and Conclusions

- **A new and improved fire detector called Multi-Criteria Fire Sensor (Mcfa) is presented.**
- **It comprises a smoke detector along with an NDIR CO and an NDIR CO₂ gas sensor.**
- **No more false alarms and faster response to all types of fires are its main advantages.**
- **Challenges still lie ahead before the Mcfa can be realized particularly the availability of resources to make it happen.**