LITERATURE REVIEW

PROJECT TITLE: INDUSTRY SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

SYSTEM 1:

MOBILE FIRE EVACUATION SYSTEM FOR LARGE PUBLIC BUILDINGS BASED ON ARTIFICIAL INTELLIGENCE AND IOT

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PUBLISHER:

IEEE-ACCESS

WORKING:

The complexity and variability of the internal environment of public buildings prompt to think about how to protect people in the fire and quickly reach the safe area. With the help of the Internet of Things, firefighting facilities, such as fire hydrants, fire extinguishers, safety evacuation signs, fire sprinklers, fire pumps, smoke, temperature, and fire doors in buildings can be dynamically monitored and controlled. In addition, based on the relevant fire emergency evacuation strategies and ideas at home and abroad, the artificial intelligence technology is used to construct an efficient and intelligent dynamic evacuation path solving model, and an intelligent mobile terminal fire evacuation system was built for large public buildings based on artificial intelligence technology. When a fire breaks out, the system can help guide people to evacuate from the building real-time and reach the safe exit quickly, so as to reduce casualties and economic losses.

ALGORITHM USED:

The ant colony algorithm is an intelligent optimization algorithm for searching the shortest path based on the principle of ant colony foraging in nature. The design idea of fire dynamic evacuation combined with ant colony algorithm.

When there is no fire, that is, in the static environment, without considering the impact of fire, the best route calculated by ant colony algorithm is the shortest path after avoiding static obstacles, in the dynamic evacuation process in case of fire, considering the influence of fire products (smoke concentration, temperature, carbon monoxide concentration), the ant colony algorithm is optimized.

FRAMEWORK OF THE SYSTEM:

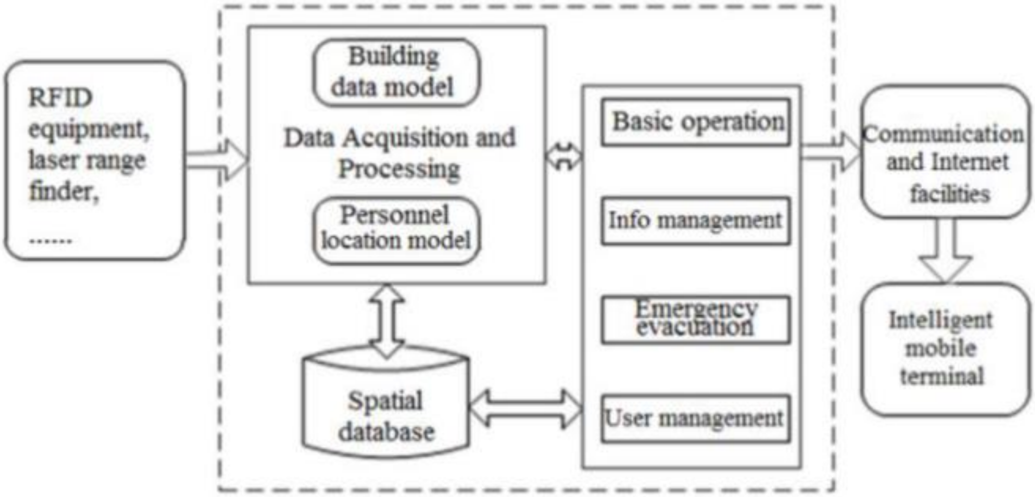
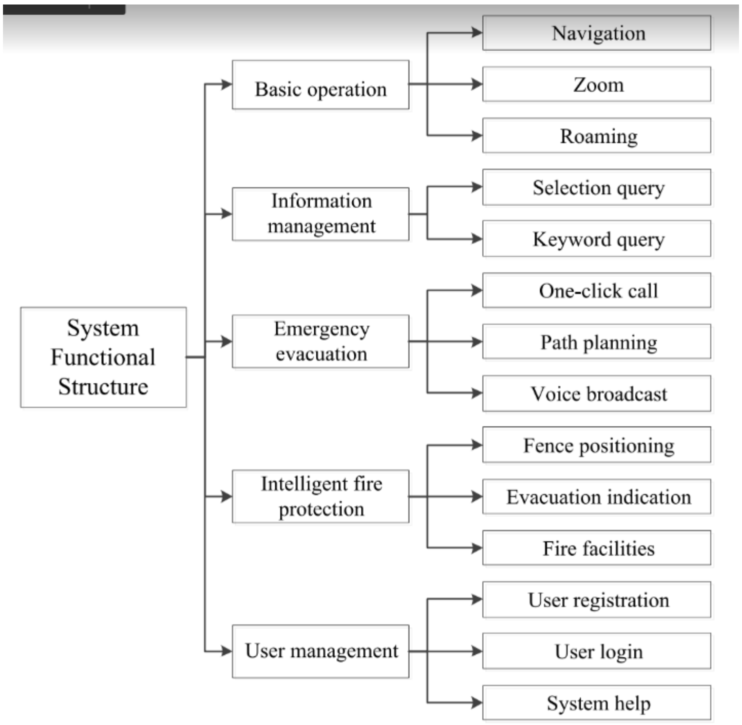


FIGURE 8. **Overall framework of the system.**

SYSTEM FUNCTIONAL STRUCTURE:



This study is based on the powerful spatial analysis function of GIS, and uses the IoT, sensor network and artificial intelligence algorithm to analyse events in the intelligent space processing system, to support the development of intelligent fire evacuation systems for large public buildings. Large public building intelligent fire evacuation system takes mobile terminal as carrier, and install sensors, RFID tags, etc. in the interior space of the building, aiming to provide technical services such as emergency evacuation guidance and escape rescue for the personnel in the disaster. In the system, IoT equipment, RFID equipment and laser rangefinder are mainly used for building and personnel information collection. The information as well as spatial data is processed and stored in the system, which is divided into four modules: basic operation, information management, emergency evacuation and user management.

SYSTEM 2:

LPWAN BASED IOT SURRVEILLANCE SYSTEM FOR OUTDOOR FIRE DETECTION

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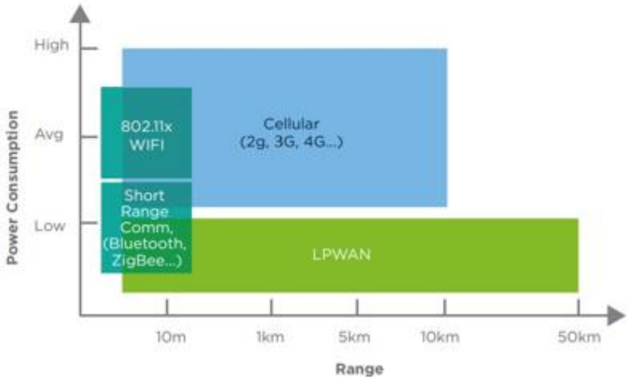
PUBLISHER: IEEE ACCESS

WORKING:

Many fire situations have represented the loss of lives and material costs due to the lack of early fire detection through smoke or gas sensing, which can become complex and critical. Meanwhile, engineers worldwide develop and test multiple systems for smoke and gas detection, commonly based on sensor networks, digital image processing, or computer vision. Furthermore, the detection system must work thoroughly with alarms and warnings that aware of a risk situation for prompt evacuation of the population in the surroundings based on a reliable data network topology with adequate device deployments that will let us know the moment a fire outbreak. This article presents a low-cost Internet of Things (IoT) prototype for fire detection in outdoor environments based on sensors and Low Power Wide Area Network (LPWAN).



The system needs to set off the alarm at the moment the LM35 sensor records a threshold temperature. It is necessary a threshold temperature to set up a threshold output voltage, which has to be linearly proportional to the Celsius temperature. Most of the outdoor applications configure a 50 $^{\circ}C$ threshold. Subsequently, the LM35 equation calculates the output voltage.

$$V_{out} = 10mv/^{\circ}C \times (50) = 500mv$$

The process consisted of a periodical data collection by sensors to bear it through the LPWAN to a database server. At the moment of exceeding the threshold values represented in Table 1, the alarm exception is triggered for sending an emergency alert by email and SMS with settings. Then, an emergency call launches a prerecorded message with an MP3 audio player shield after the answering of the mobile, indicating the sensor geographic coordinates that triggered the alarm.

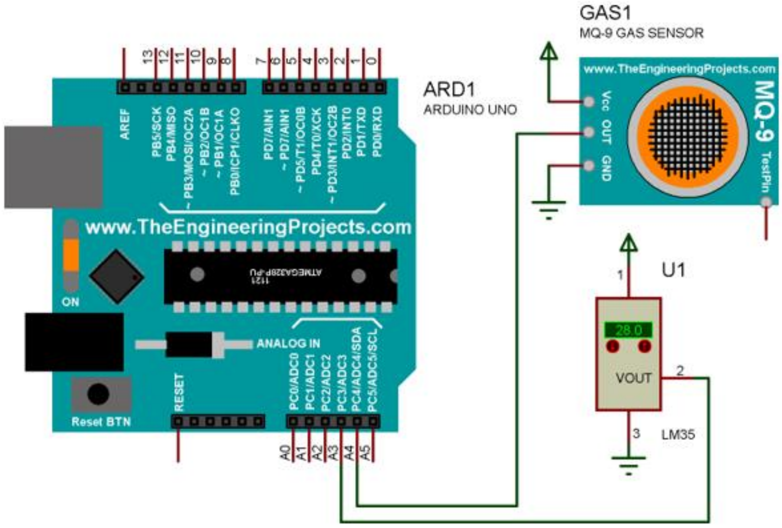
Table 1:

TABLE 1. Gas tolerable critical values for short-term exposure.

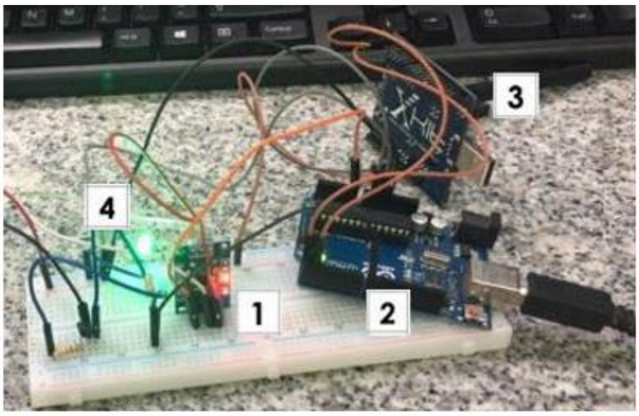
Compound	Formula	Values for Human Escape (ppm)
Hydrogen cyanide	HCN	80-100
Hydrogen chloride	HCl	50-1000
Benzene	C_6H_6	1500-4000
Nitric oxide+Nitrogen dioxide	$NO+NO_2$	100
Sulfur dioxide	SO_2	150
Chlorine	Cl_2	50
Cobalt chloride	$CoCl_3$	12.5
Amonia	NH_3	2500
Carbon monoxide	CO	1500-4000
Carbon dioxide	CO_2	40000-80000
Oxygen	O_2	60000-100000
Temperature	C	140
Smoke	OD	0.22 m^{-1}

The system uses the SigFox back-end for sending the warning email and SMS through a callback done by the Ubidots platform. Through the integration of this platform, we collected the data generated by the nodes for allows data storage in the cloud, providing at the same time dashboard options for consulting recorded information by visual interfacing through a website. As an IoT cloud service- oriented platform, it allows the connection of devices to its API (application programming interface) to interact with its elements, such as data source, variables, values, and events to either create, modify or remove them.

INTEGRATED CONNECTION:



LOW SCALE PROTOTYPE CIRCUIT:



SYSTEM 3:

ADVANCES TOWARD THE NEXT GENERATION FIRE DETECTION: DEEP LSTM VARIATIONAL AUTOENCODER FOR IMPROVED SENSITIVITY AND RELIABILITY

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Fire detection is a critical component of a building safety monitoring system and remains an important research area with weighty practical relevance. Significant advances have occurred in recent years in building automation, and the operation of buildings has become more complex and requires ever more effective monitoring systems. They develop a novel fire detection method using deep Long-Short Term Memory (LSTM) neural networks and variational autoencoder (VAE) to meet these increasingly stringent requirements and outperform existing fire detection methods. To evaluate the effectiveness of their method, they develop high-fidelity simulations, and they use datasets from real-world fire and non-fire experiments provided by NIST.

By comparing the performance of our proposed fire detection with alternative methods, including the standard LSTM, cumulative sum control chart (CUSUM), exponentially weighted moving average (EWMA), and two currently used fixed-temperature heat detectors. The results using the simulation-based and the real-world experiments are complementary, and they indicate that the LSTM-VAE robustly outperforms the other detection methods with, for example, statistically significant shorter alarm time lags, no missed detection, and no false alarms. The results also identify shortcomings of other detection methods and indicate a clear ranking among them.

Z. Xu *et al.*: Advances Toward the Next Generation Fire Detection:

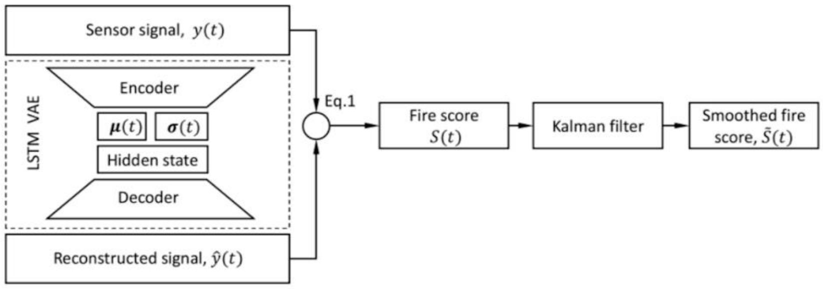

FIGURE 1. Architecture of the proposed LSTM-VAE fire detection.

LSTM-VAE FIRE DETECTION METHOD:

- LONG SHORT-TERM MEMORY (LSTM) NEURAL NETWORK
- VARIATOINAL AUTOENCODER
- KALMAN FILTER-ALGORITHM
- ALARM CRITERIA FOR THE SMOOTHED FIRE SCORE

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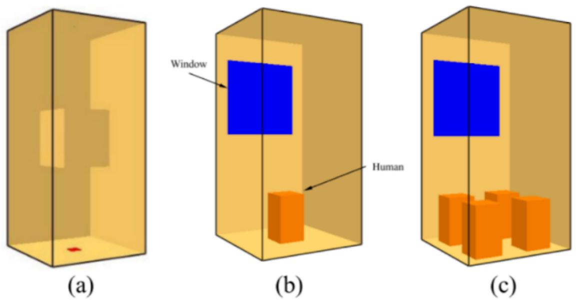

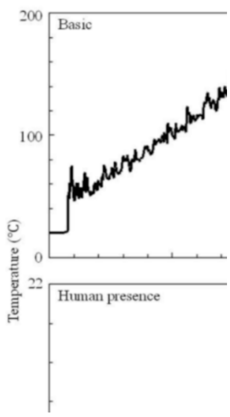

FIGURE 5. Additional scenarios: (a) fire-obstacle scenario; (b) single human presence, light perturbation but no fire scenario; (c) multiple human presence, medium perturbation but no fire scenario.

RESULTS:

The results of the simulation-based computational experiments. They then did the same for the two real-world datasets, the flaming chair and heated PU foam. Finally, They provide the results for the entire 69 datasets, and they conclude with a synthesis of the comparative performance analysis of our LSTM-VAE fire detection against other methods.

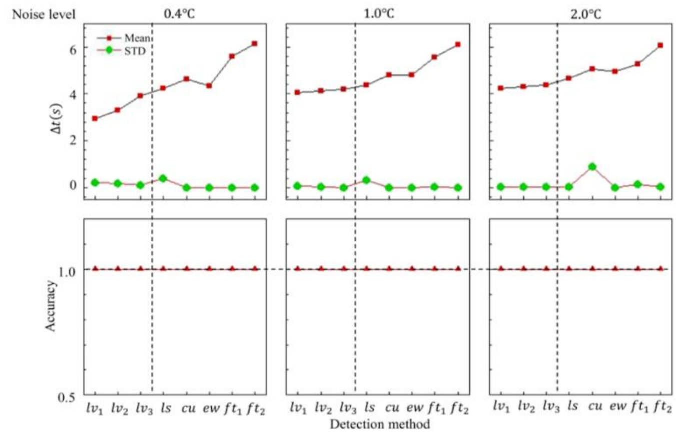

FIGURE 10. Mean and standard deviation (STD) of the alarm time lag and accuracy of the different fire detection methods in the basic fire scenario.