Four types of wildfire surveillance and monitoring could be distinguished:

- Traditional human wildfire surveillance and monitoring.
- Video cameras based human wildfire surveillance and monitoring.
- Automatic wildfire detection.
- Advance automatic wildfire surveillance and monitoring.

Traditional human wildfire surveillance is based on trained human observers located on selected monitoring locations, usually hills or watching towers. Human observers are in most cases equipped only with standard binoculars and communication equipment. Although technologically simple to implement, significant human resources are required, which makes it difficult to be put into practice.

Technically more advanced approach to human wildfire surveillance is **video cameras based human wildfire surveillance**
. Now remotely controlled video cameras are installed on monitoring locations and the human observer is located in monitoring centre equipped with adequate video presentation and video storing devices. Monitoring center is connected wirelessly or by wires with distant video cameras located on monitoring spots. This kind of wildfire surveillance has many advantages in comparison to direct human observation from monitoring spots.

The most important of them are:

a) The human observer is capable to monitor a wider area covered by few video monitoring field units in comparison with human location on only one monitoring spot.

b) Cameras are usually equipped with power zoom (at least optical zoom with 22 x magnification), so the observer could easily inspect suspected areas.

c) System usually has video storing capabilities, at least for the last couple of days, and that could be quite useful for post-fire analysis.

It is important to emphasize that video based systems could be used not only for early fire detection, but also for distant video presence. The greatest limitation of such system is that wildfire detection depends entirely on a human observer. Human observer detects the fire. The observer has to watch carefully computer screens all the time, so problems like fatigue, boredom and lost of concentration could be encountered.

The next technical improvement is **automatic wildfire detection**. The research and system development in the area of automatic wildfire detection was extended in the last couple of years. Automatic wildfire detection could be realized by:

a) Satellite systems based on monitoring from satellites,

b) Airplane systems based on monitoring from various flying vehicles, and

c) Terrestrial systems based on monitoring from ground monitoring stations.

Satellite systems are suitable for monitoring wide areas, but for monitoring areas like Mediterranean coast and islands, terrestrial or ground-based systems are more suitable. There is lot of reasons for that but let us emphasize only two topics why terrestrial systems are better choice:

o The spatial and time resolution of satellite systems is not satisfactory.

o Satellite systems are capable only to detect fires, but for firefighters distant video presence is of equal imprtance.

Sometimes ***airplane-based systems*** are used to monitor wide forest areas, like Canada or Siberia. Their space resolution is better, but time resolution could be even worse in comparison with satellite based systems.

In **terrestrial systems** different kinds of fire detection sensors could be used:

- Video cameras sensitive in visible spectra. Their detection is based on smoke recognition during the day and fire flame recognition during the night. These systems are the main topic of this site.

>> Smoke Detection Algorithms

- Infrared (IR) thermal imaging cameras. Their detection is based on detection of heat flux from the fire.

>> Arrue, B.C.; Ollero, A.; de Dios, J.R.M., An intelligent system for false alarm reduction in infrared forest fire detection, IEEE Intelligent Systems & Their Applications 2000, 15 (3), 64-73. >>> http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=846287

- Optical spectrometry that identify the spectral characteristics of smoke.

>> Forest Fire Finder, NGNS IS >>> http://www.ngns-is.com/site_html/produtos/fff_esp_eng.html

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- Light detection and ranging (LIDAR) systems that measure laser light backscattered by the smoke particles.

>> Utkin, A.; Vilar,R., Feasibility of forest-fire smoke detection using lidar, International Journal of Wildland Fire 2003, 12(2) 159 - 166 >>> http://www.publish.csiro.au/paper/WF02048.htm

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- Radio-Acoustic Sounding System (RASS) for remote temperature measurements and thermal sensing of a particular forest region.

>> Guneri, Y.; Turker Ince, S.; Early Forest Fire Detection Using Radio-Acoustic Sounding System, Sensors 2009, 9, 1485-1498 >>> http://www.mdpi.com/1424-8220/9/3/1485/

- Acoustic Volumetric Scanner (VAS) that recognize the fire acoustic emission spectrum as a result of acoustic fire sensing - developed within the EU-FIRE project.

>> EU-FIRE Project >>> http://www.eufire.org/home.aspx

>> Viegas .X, Pita L.P.; Nielsen F, K. Haddad:Calisti Tassini C, D'Altrui G. Quaranta V., Dimino I, Acoustic and thermal characterization of a forest fire event ,Proceedings of SPIE, Remote sensing of fire, San Diego CA , 2008 , vol. 7089, pp. 708904.1-708904.12 >>> http://spie.org/x648.html?product_id=794601

- Sensor network based system, where a number of sensor nodes (in most cases wirelless sensors) are deployed in forest, measuring different environmental variables used for fire detection. There are lot of different approaches, from more or less standard

- wirelles sensor nodes,

>> Byungrak Son, Yong-sork Her, and Jung-Gyu Kim, A Design and Implementation of Forest-Fires Surveillance System based on Wireless Sensor Networks for South Korea Mountains, IJCSNS Int. Journal of Computer Science and Network Security, VOL.6 No.9B, September 2006, pp.124-130 >>> http://paper.ijcsns.org/07_book/html/200609/200609118.html

- application of so called Fiber Optic Sensor Network (FOSN) developed within the EU-FIRE project,

>> D. X. Viegas, L. P. Pita, K. Haddad, C. Calisti Tassini, A. Gemelli, V. Quaranta, I. Dimino & H. Tsangaris , An innovative approach to forest fires detection and monitoring: the EU-FIRE project, Safety and Security Engineering III, WIT eLibrary >>> http://library.witpress.com/pages/PaperInfo.asp?PaperID=20331

>> EU-FIRE Project >>> http://www.eufire.org/home.aspx

to exotic proposals where animals have to be used as mobile biological sensors equiped with sensor nodes.

>> Sahin Y., Animals as Mobile Biological Sensors for Forest Fire Detection, Sensors 2007, 7, 3084-3099 >>> http://www.mdpi.com/1424-8220/7/12/3084/

By integrating automatic wildfire surveillance and monitoring system with real time meteorological data, geographic information system (GIS) data, meteorological simulations, fire risk index calculation and fire spread simulation, a lot of new features could be added. The

result of such integration is the **advanced automatic wildfire surveillance and monitoring system.** These systems could be used not only for early fire detection and distant video presence at fire location, but also for various activities connected with pre fire, fire and post fire stages.

>> Caballero, D., Viegas, D.X., Xanthopoulos, G., 2001. E-FIS: an electronic on-line decision support system for forest fires, Int. Workshop on Improving dispatching for forest fire control. Med. Agronomic Institute of Chania, Crete, Greece. December 6-8, 2001 >>> http://www.maich.gr/fire_workshop/proceedings

>> B. Hrastnik, Branimir; D. Stipaničev, R. Vujčić, Forest Fire Protection by 24h Monitoring, Wood Collection Intended for District Heating Plants and Easy Access Routes Assigned to Firemen and Tourism, 2nd World Conference on Biomass for Energy, Industry and Climate Protection ETA-Florence, Italy and WIP-Munich, Germany , 2004.. V3.36. >>> http://laris.fesb.hr/PDF/v3-36-hrastnik-stipanicev-vujcic.pdf

>> Trevis, L., El-Sheimy, N., The developement of a real-time forest fire monitoring and management system, XX ISPRS Congress, Istanbul, 12-23 July 2004. >>> http://www.isprs.org/proceedings/XXXV/congress/yf/papers/932.pdf

>> D.Stipaničev,T.Vuko,D.Krstinić,M.Štula,Lj.Bodrožić, Forest Fire Protection by Advanced Video Detection System - Croatian Experiences , Third TIEMS Workshop – Improvement of Disaster Management System, Trogir, Sept. 26 – 27, 2006 >>> http://laris.fesb.hr/PDF/TIEMS%20-%20Stipanicev_i_ostali.pdf

>> Martinez-de Dioa, J.R., Arrue, B.C., Ollero, A., Merino, L., Gomaz-Rodrigez, F. Computer vision techniqes for forest fire perception, Image and Vision Computing 26 (2008) 550-562 >>> http://grvc.us.es/aware/papers/aware_paper_9.pdf

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Covering the whole region with several inter-connected automatic wildfire monitoring units the **wildfire monitoring network**
could be formed. The network architecture has a lot of advantages emphasized in DICES project, PRODALIS project in Landes region, France or Istra iForestFire Net, Croatia.

>> DICES project >>> Martinez-de Dioa, J.R., Arrue, B.C., Ollero, A., Distributed intelligent automatic forest-fire detection system, INNOCAP'99 - Sensor Networks and Communications, Grenoble, April 28-29 >>> http://grvc.us.es/publica/congresosint/documentos/CI-055.99Distributed intelligent automatic.pdf

>> PRODALIS project >>> PRODALIS, un programme pilote en France, http://www.alpi40.fr/article/articleview/3657/1/587

>> Istra iForestFire Net >>> D.Stipaničev, M.Štula, D.Krstinić, Lj.Šerić, T.jakovčević, M.Bugarić,

Advanced automatic wildfire surveillance and monitoring network, VI International Conference on Forest Fire Research, Coimbra, Porugal, Nov. 15 – 18, 2010. >>> http://www.adai.pt/icffr/2010/index.php?target=presentations