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ENVIRONMENTAL PHYSICS & MODELING COMPLEX SYSTEMS

ABSTRACT & KEYWORDS

- Advanced physical technologies developed in the research laboratories of the Moldova State University (MSU) are used in the monitoring of environmental factors with the application of UVS (Unmanned Vehicle Systems). The aim of research is development of an integrated mobile system for the exact monitoring and computational modeling of environmental factors. This presentation deals with the first advisable stage related to a drone-dedicated system for the observation and support of the air analysis for pollution, chemical and radiological contaminations. The exact data can then be used in modeling of the impact of biotic and abiotic factors during the real-time environmental monitoring process.

- Keywords – Environmental monitoring, physical methods and technologies, Unmanned Vehicle Systems, Unmanned Aerial Vehicle, health effects of PM-pollution.

INTRODUCTION

2016 — **European project "Educational for Drone" (eDrone, 574090-EPP-1-2016-1-IT-EPPKA2CBHE-JP)**

2018 — **Office for Education for Drones (OED) at the MSU**

2020 — **Advanced physical technologies with the UVS application in monitoring and modelling of environmental factors**

Office for Education for Drones at the MSU

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UNIVERSITÀ DEGLI STUDI DEL SANNIO Benevento

eDrone EDUCATIONAL FOR DRONE

SmartCity SOWA environment monitoring platform

Multispectral camera Survey 3W

FLIR Vue Pro R infrared camera

LiDAR 3D mobile scanner

**Drones: DongYang D800-X4,
DJI Phantom 4 Pro & drone equipment**

eDrone CTT & CIA courses deployment and set-up

Air content analysis system SOWA

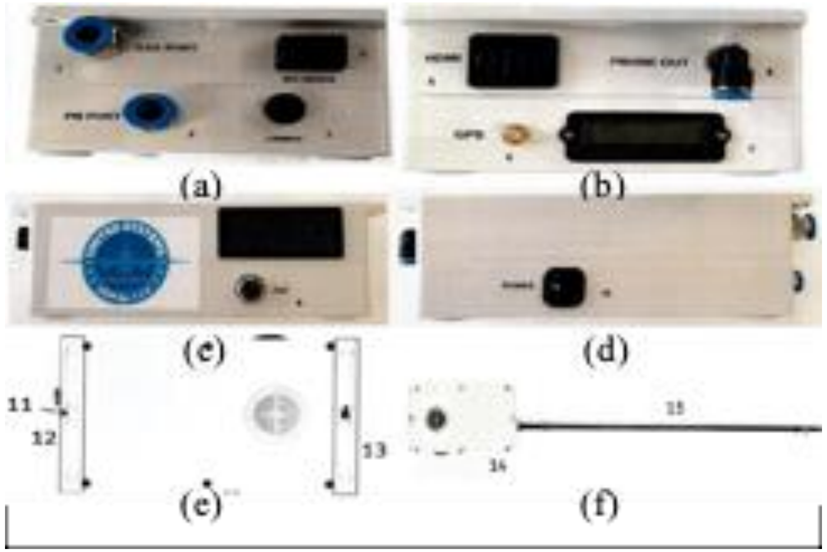
Measuring Station

Functionality:
PM, Organic compounds, Formaldehyde, Hydrogen chloride,
Hydrogen cyanide detection;
Humidity range:
from 0 to 100 % RH;
Pressure range: from 300 to 1100 hPa.

Physical characteristics:
Dimensions: 220x150x80 mm;
Weight: 1100 g;
Power supply:
battery Lithium-ion
up to 3 hours;
Power supply charging: 9-29 V, drone supplied, PoE 802.3af; Connectors.

DESCRIPTION OF DEVICE ELEMENTS

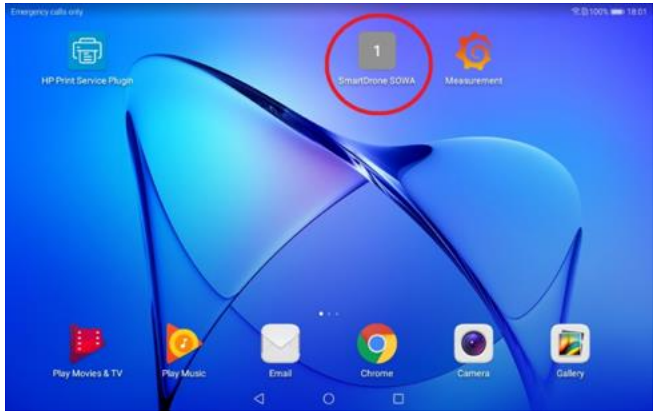
Air content analysis system is a mobile air laboratory, which allows reading air content directly from the source, and it is equipped with a built-in HD camera transmitting the image with the measured parameters to the station operator.



Front (a), rear (b), left side (c),
and right side (d) of the measuring station,
and its components,
(e) and (f).

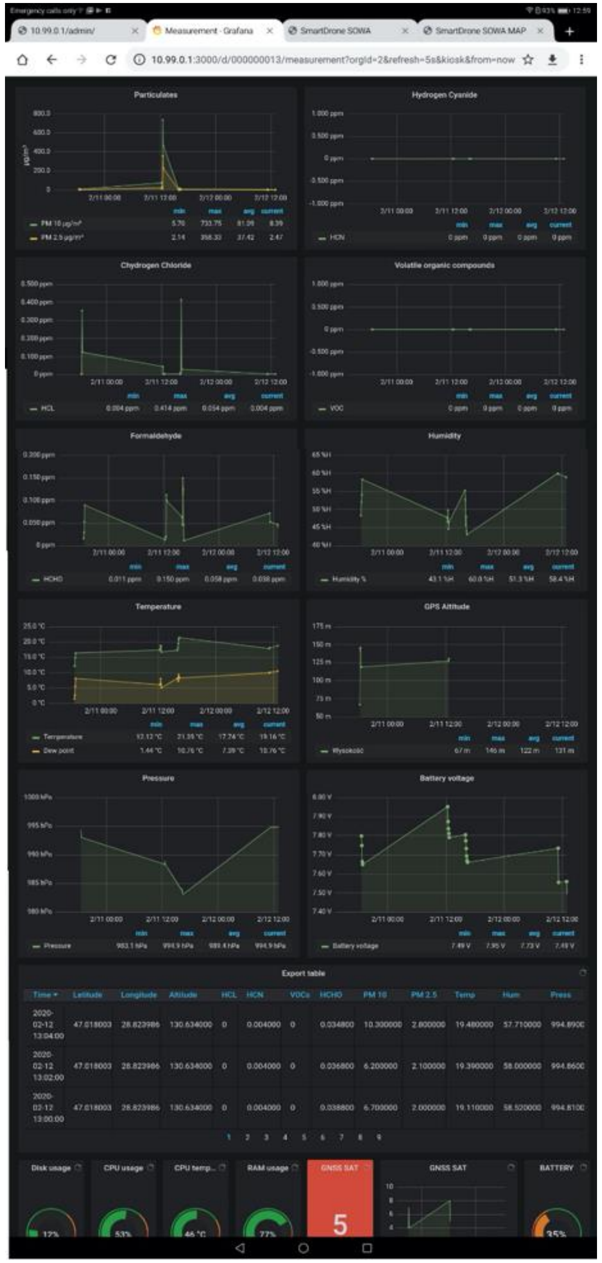
1. Gas intake;
2. Dust intake;
3. Built-in HD video camera;
4. Temperature, humidity and pressure sensors;
5. HDMI video output;
6. GPS antenna connector;
7. Battery charge indicator;
8. Air outlet from measuring chamber;
9. Power socket/LAN (PoE);
10. Power switch;
11. Place where the screw is attached to the handle;
12. Front grip fixing strip;
13. Rear grip fixing strip;
14. Measuring laboratory;
15. Measuring probes.

PERFORMING MEASUREMENTS



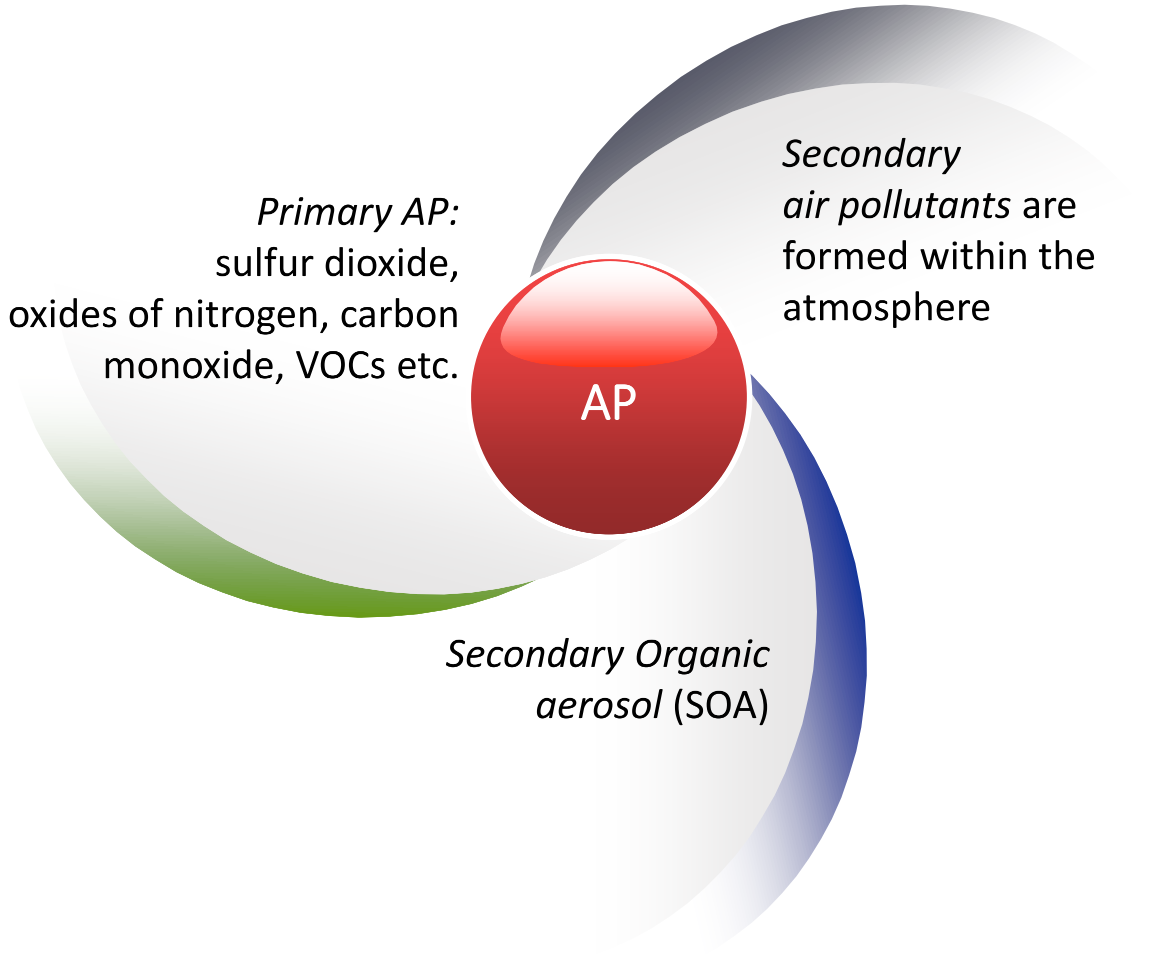
Web browser on the tablet screen.

System login screen view.



Charts with historical data view.

AIR POLLUTANTS (AP): GASEOUS & PARTICULATE



EXPERIMENTAL RESULTS AND DISCUSSION

Data view during outdoor measurement & combustion experiment

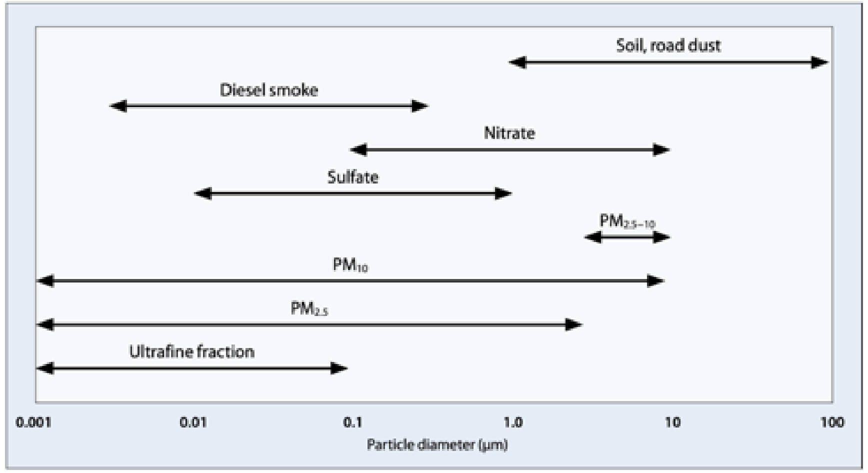
PM_{10}=36.0 μg/m^3
$PM_{2.5}$=16.6 μg/m^3
Hydrogen Cyanide=0 ppm
Hydrogen Chloride=0 ppm
VOCs=0 ppm
Formaldehyde=0.0236 ppm

PM_{10}=1307.3 μg/m^3
$PM_{2.5}$=582.1 μg/m^3
Hydrogen Cyanide=0.004 ppm
Hydrogen Chloride=0 ppm
VOCs=0 ppm
Formaldehyde=0.2140 ppm

WHO Air Quality Guidelines for 24-hour means of *Particulate Matter* (PM):
PM_{10}=50.0 μg/m^3
$PM_{2.5}$=25.0 μg/m^3

PM-Pollution

Schematic representation of airborne particles and their size range



Air quality category	PM_{10} µg/m^3 averaged over 1 hour
Good	Less than 40
Moderate	40–80
Poor	80–120
Very poor	120–240
Hazardous	More than 240

Secondary air pollutants are formed from chemical reactions of primary pollutants involving the natural atmosphere components:

$NO + O_3 \rightarrow NO_2$ (nitrogen dioxide) $+ O_2$;
$NO_2 + h\upsilon$ ($\lambda \leq 430$ nm) $\rightarrow NO + O$;
$O + O_2 \rightarrow O_3$;
$NO + RO_2$ (alkyl peroxide) $\rightarrow NO_2 + RO$;
$HNO_3 + NH_3$ (ammonia) $\leftrightarrow NH_4NO_3$