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# ITU-T

TELECOMMUNICATION  
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OF ITU

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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

E-health multimedia systems, services and applications –  
Multimedia e-health data exchange services

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## **Framework for information and communication technology olfactory function test systems**

Recommendation ITU-T H.862.4

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## Recommendation ITU-T H.862.4

### Framework for information and communication technology olfactory function test systems

#### Summary

Recommendation ITU-T H.862.4 defines the framework for information and communication technology (ICT) olfactory function test systems. The scope of this Recommendation is focused on the method of the olfactory function test generated by the perception of the user's condition, the mechanically controlled scents spray, the evaluation of the user's response, and the olfactory test procedures.

The olfactory function test can be carried out by considering human factors related to the human olfactory. It can be sprayed by mechanically controlling a certain amount of fragrance. It is also possible to present a fragrance at intervals optimized for olfactory fatigue. In addition, it is possible to prevent the fragrance from being perceived completely differently due to the residual fragrance by solving the problem of fragrance mixing between olfactory tests through cleaning.

The ICT olfactory function test system framework is largely composed of three stages. The first step is to judge the state of the user and determine whether it is possible to perform an olfactory test. The second step is to emit an appropriate fragrance and receive a response from the user according to the test procedure. The third step is to evaluate the user's olfactory ability by analysing the user's response to the test procedure.

#### History

| Edition | Recommendation | Approval   | Study Group | Unique ID*   |
|---------|----------------|------------|-------------|--|
| 1.0     | ITU-T H.862.4  | 2021-06-13 | 16          | <a href="http://handle.itu.int/11.1002/1000/11830-en">11.1002/1000/14689</a> |

#### Keywords

Dementia, human factors, ICT olfactory function test, scent diffusing system.

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# **Recommendation ITU-T H.862.4**

## **Framework for information and communication technology olfactory function test systems**

### **1 Scope**

This Recommendation describes the framework for an olfactory function test system.

In particular, the scope of this Recommendation includes:

- Architectural framework;
- System framework entities;
- Olfactory function test procedures.

### **2 References**

None.

### **3 Definitions**

#### **3.1 Terms defined elsewhere**

This Recommendation uses the following terms defined elsewhere:

**3.1.1 biosignal** [b-ITU-T X.1094]: Any measurable signal in living beings (physical, chemical or electrical) that can be measured or monitored, such as a ballistocardiogram (BCG), electroencephalogram (EEG), electrocardiogram (ECG) and photoplethysmogram (PPG).

#### **3.2 Terms defined in this Recommendation**

This Recommendation defines the following terms:

**3.2.1 olfactory fatigue**: The temporary inability to distinguish a particular odour after prolonged exposure to that scent.

**3.2.2 olfactory function**: The ability to detect odorous substances in the air through the nose.

### **4 Abbreviations and acronyms**

This Recommendation uses the following abbreviations and acronyms:

EEG    Electroencephalogram

ICT    Information and Communication Technology

### **5 Conventions**

None.

### **6 Background**

Olfactory function is not only a simple sense of smell in daily life but is also an essential function of safety that enables humans to be evacuated in advance from any dangerous situation. Many tests for olfactory disorders have been widely conducted. The existing olfactory test is in the form of a scent and questionnaire using a scratch paper, pen, and a bottle. Recently, the information and communication technology (ICT)-based olfactory test method has been spreading widely.

The olfactory test is largely divided into four types, which consists of a method of measuring identification, discrimination, recognition, and the threshold of smell. In addition to this, the olfactory function test has been proven to be related to the cognitive function and has recently been gaining currency as an early screening tool for dementia such as the Alzheimer's disease. However, a problem has risen in the effectiveness of the inspection being limited due to the inaccuracies of the questionnaire method.

The olfactory test examines every step from detecting the smell of the nose to the memory process in the brain. It is classified according to the function of each stage and consists of four measurement types: odour identification, olfactory discrimination, odour recognition, and olfactory threshold. The olfactory test is currently widely used in otolaryngology hospitals as a tool to measure olfactory-related diseases, and dementia screening tests are also being attempted in neurology hospitals.

## **7 System framework architecture**

The questionnaire olfactory test is a method in which the fragrance is brought directly into the nose and smelled, so the amount of incense flowing into the nose is not uniform. Since the fragrances must be presented manually, the interval between them is not constant, and if a specific odour is smelled repeatedly, the probability of olfactory fatigue that changes olfactory ability increases. In addition, the difficulty of cleaning the residual scent mixes, after the fragrance presentation in the questionnaire method is also a problem. This being an important factor as it lowers the effect of the examination due to the characteristic of the smell of sense which perceives the fragrance differently even with slight changes in the smell.

The olfactory performance test can be carried out by considering human factors related to the human olfactory. It can be sprayed by mechanically controlling a certain amount of fragrance, and the fragrance can be sprayed at intervals that is optimized for olfactory fatigue. It is also possible to prevent the fragrance from being perceived completely differently due to the residual fragrance by solving the problem of fragrance mixing between olfactory tests through cleaning.

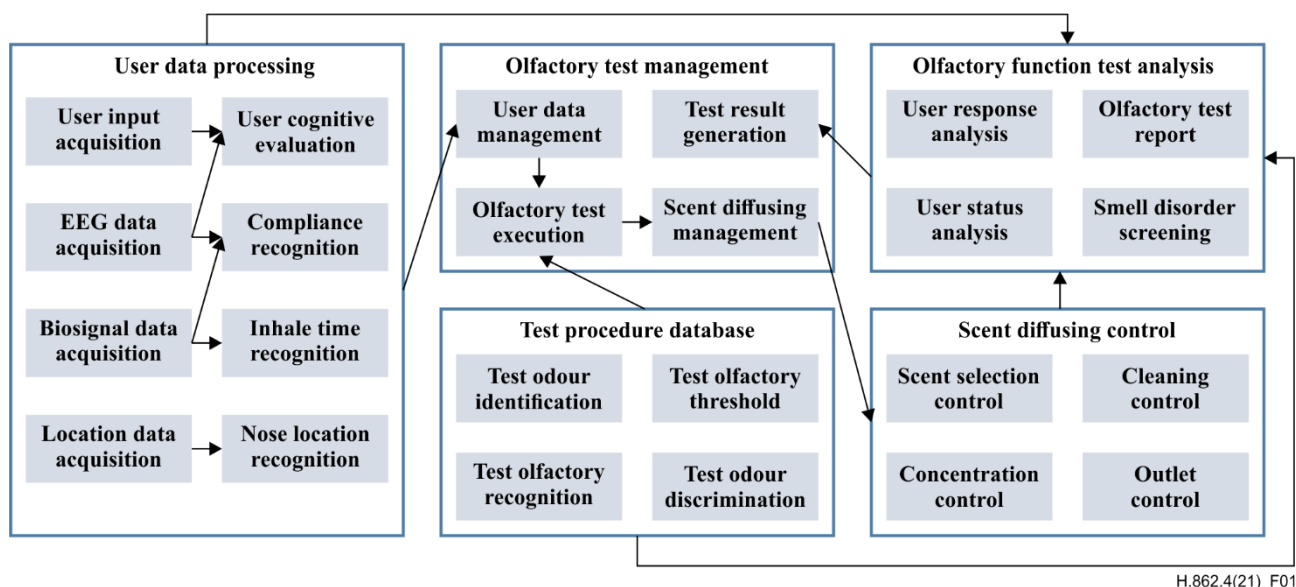
The olfactory performance testing framework consists of three stages.

The user data processing measures the user's condition in determining whether an olfactory inspection is suitable while also helping to focus on the inspection.

The olfactory test management manages to spray the scent according to the test procedure database and receive the user's scent evaluation input.

The scent diffusing system controls the scent of a certain concentration and mass and performs cleaning for residual scent through the outside air. At the same time, the olfactory function test analysis receives the response of four types of olfactory tests and then analyses user input to perform olfactory tests.





**Figure 1 – ICT-based olfactory function test system framework**

## **8 System framework entities**

### **8.1 User data processing module**

This module receives the user's input electroencephalogram (EEG) signal, biosignal and location for the olfactory test and processes it by pattern recognition to automatically recognize the user's status and whether to comply with the test, the time to smell the fragrance and the location of the nose.

#### **8.1.1 User input acquisition submodule**

This submodule receives input through the user's screen and voice, then stores it.

#### **8.1.2 EEG data acquisition submodule**

The EEG signal attached to the user's head stores the EEG signal within 100 ms after the fragrance is injected.

#### **8.1.3 Biosignal data acquisition submodule**

This submodule stores signals collected by remote or attached biosignal equipment.

#### **8.1.4 Location data acquisition submodule**

This submodule measures and stores information about the distance between the user and the fragrance.

#### **8.1.5 User cognitive evaluation submodule**

The validity of user input is evaluated through user input value and EEG signal.

- Input: user input data, user EEG data
- Output: user cognition evaluation result

#### **8.1.6 Compliance recognition submodule**

This submodule interprets the user's EEG signal and biosignal data to recognize the user's compliance with the test.

- Input: user EEG data, user biosignal data
- Output: user compliance recognition result

### **8.1.7 Inhale time recognition submodule**

This submodule analyses user's biosignal data to recognize the user's inhale time in a breath.

- Input: user biosignal data
- Output: user inhale time result

### **8.1.8 Nose location recognition submodule**

This submodule recognizes the user's nose location through location data.

- Input: user location data
- Output: user inhale time result

## **8.2 Olfactory test management module**

After receiving the information of the user receiving the olfactory test, fusion is performed, and the olfactory test is performed using the olfactory test procedure, the scent is executed accordingly, and the result is generated according to the olfactory test.

### **8.2.1 User data management submodule**

This submodule receives and fuses user data and provides it for olfactory inspection.

- Input: user data
- Output: user information

### **8.2.2 Olfactory test execution submodule**

This submodule performs the olfactory inspection procedure based on the user's information and the fragrance information is generated accordingly.

- Input: user information, test procedure database
- Output: scent diffusing data

### **8.2.3 Scent diffusing management submodule**

This submodule generates data that can control the scent diffusing device to generate scent diffusing information.

- Input: scent diffusing information
- Output: scent diffusing procedure

### **8.2.4 Test result generation submodule**

This submodule generates information to the user by using the olfactory function test result.

- Input: test analysis data
- Output: test analysis display

## **8.3 Test procedure database module**

This module provides an olfactory test procedure suitable for olfactory test steps.

- Input: pre-defined database
- Output: olfactory test procedure

### **8.3.1 Test odour identification submodule**

This submodule sprays one type of familiar fragrance to check whether it is identified from the names of fragrances presented on the screen view.

### **8.3.2 Olfactory threshold submodule**

This submodule uses a special fragrance and measures the minimum concentration that can smell incense with one step i.e., from low to high.

### **8.3.3 Test olfactory recognition submodule**

This submodule sprays some of the fragrances, the rest of the fragrances are then sprayed to check if the overlapped scents can be recognized.

### **8.3.4 Test odour discrimination submodule**

This submodule randomly sprays two types of scents respectively to check and prevent odour discrimination.

## **8.4 Scent diffusing control module**

This module controls scent diffusing, which is composed of submodules to select the fragrance, adjust the concentration of the fragrance, scent outlet and to clean the inside.

- Input: scent diffusing procedure
- Output: scent diffusing result

### **8.4.1 Scent selection control submodule**

This submodule opens and closes the associated valve to create the selected fragrance.

### **8.4.2 Concentration control submodule**

This submodule adjusts the combination of fragrance and air to adjust the concentration of fragrance.

### **8.4.3 Outlet control submodule**

This submodule adjusts the opening and closing of the outlet to discharge the fragrance at a predetermined intensity.

### **8.4.4 Cleaning control submodule**

This submodule cleans the inside of the contaminated sprayed scent.

## **8.5 Olfactory function test analysis module**

This module analyses the user's sense of smell according to the result of the olfactory function and screens the problem of the smell accordingly.

- Input: user data information, test procedure data, scent diffusing result
- Output: test analysis data

### **8.5.1 User response analysis submodule**

This submodule reviews the user's data and analyse the reliability of the response.

### **8.5.2 User status analysis submodule**

This submodule compares and analyses the comparative group and olfactory test result according to the user's status.

### **8.5.3 Olfactory test report submodule**

This submodule analyses test results according to the user's response in various test procedures.

### **8.5.4 Smell disorder screening submodule**

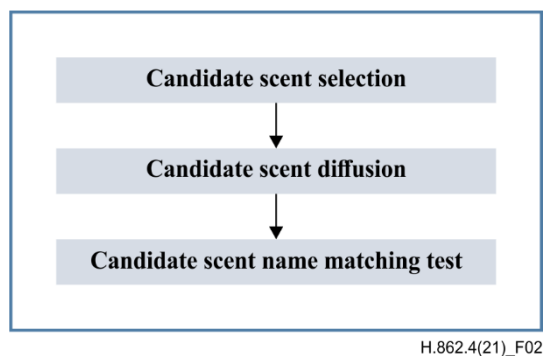
This submodule analyses the tendency of various olfactory disorders and screens the smell disorders.

## 9 Olfactory function test procedures

These test procedures consist of the most commonly used four types of olfactory function tests in the hospitals, and each of which examines a person's ability to smell at each stage of the olfactory process.

### 9.1 Test odour identification

The purpose of the test odour identification is to test whether the brain can process information about the smell by seeing whether the user can identify or remember the name of the scent. To do this, a candidate is presented, multiple scent names are presented in the multiple-choice, and the user's answer is collected to evaluate whether it is correct.



**Figure 2 – Test odour identification procedure**

#### 9.1.1 Candidate scent selection

This procedure sets the candidate scent to diffuse from first to last.

#### 9.1.2 Candidate scent diffusion

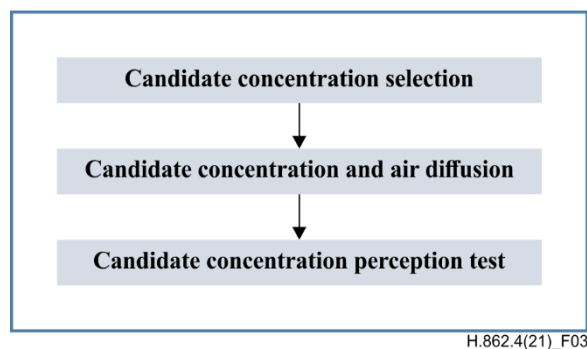
This procedure sprays the user with the selected scent.

#### 9.1.3 Candidate scent name matching test

This procedure tests to see if the user can name the candidate scent in the multiple-choice.

### 9.2 Test olfactory threshold

The purpose of the test olfactory threshold is to test the sensitivity of a person's sense of smell by measuring the concentration with the lowest odour. For this, the lowest concentration that can be perceived by the sense of smell is obtained by measuring whether the scent can be smelled by increasing its concentration sequentially.



**Figure 3 – Test olfactory threshold procedure**

#### 9.2.1 Candidate concentration selection

This procedure sets the candidate concentration to diffuse from minimum to maximum.

### 9.2.2 Candidate concentration and air diffusion

This procedure randomly sprays the user with the selected concentration of scent once, air twice or more.

### 9.2.3 Candidate concentration perception test

This procedure tests to see if the user can perceive the candidate concentration of scent from the air in the multiple-choice.

## 9.3 Test olfactory recognition

The purpose of the olfactory test recognition is to test if the user can remember the scent which is previously smelled in memory and remembered when smelled again. To do this, after suggesting and memorizing a scent, multiple scents are presented to evaluate if they can find a previously memorized scent.

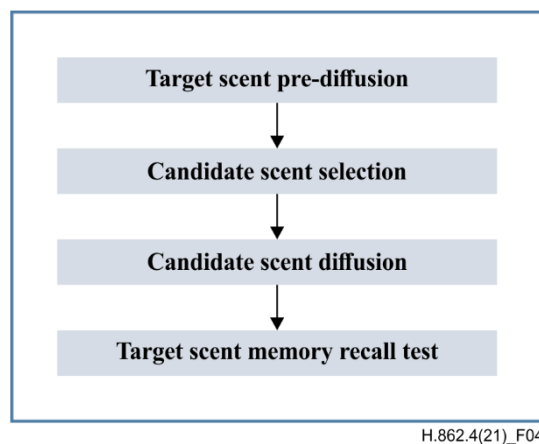


Figure 4 – Test olfactory recognition procedure

### 9.3.1 Target scent pre-diffusion

This procedure sprays the target scent to remember it in advance.

### 9.3.2 Candidate scent selection

This procedure randomly sets the candidate scent to diffuse between the target scent and the distracting scent.

### 9.3.3 Candidate scent diffusion

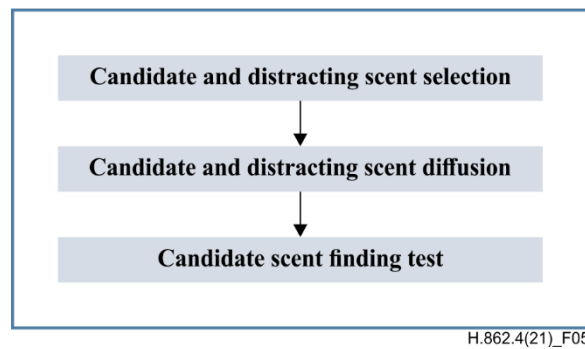
This procedure sprays the user with the selected scent.

### 9.3.4 Target scent memory recall test

This procedure tests to see if the user can recall the target scent memory from the candidate scent.

## 9.4 Test odour discrimination

The purpose of the test odour discrimination is to evaluate whether the user's sense of smell can recognize and distinguish differences in odours. To this end, the user is sequentially sprayed with the same scent and one different scent and evaluated whether it is possible to distinguish the other scent.



**Figure 5 – Test odour discrimination procedure**

#### **9.4.1 Candidate & distracting scent selection**

This procedure sets the candidate & distracting scent to diffuse from first to last.

#### **9.4.2 Candidate & distracting scent diffusion**

This procedure randomly sprays the user with the selected scent once, the distracting scent twice or more.

#### **9.4.3 Candidate scent finding test**

This procedure tests to see if the user can find the candidate scent from the distracting scent in the multiple-choice.

## **Bibliography**

- [b-ITU-T X.1094] Recommendation ITU-T X.1094 (2019), *Telebiometric authentication using biosignals*.







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