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Information technology — Affective computing user interface (AUI) —

Part 2: Affective characteristics

Technologies de l'information — Interface pour la reconnaissance et la simulation des émotions (AUI) —

Partie 2: Caractéristiques de reconnaissance et de simulation des émotions

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Foreword

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Introduction

Affective computing builds a harmonious human-computer environment by enabling computing systems to recognize, interpret, and simulate human affects. Affective applications promise new insights into what people are feeling and can better serve their needs. It is important to consider affective characteristics of humans in the design and presentation of affective computing user interface (AUI).

Limitations on affective computing include diverse affective characteristics currently used and the way to interpret and identify these affective characteristics. A general and systematic technical report is needed to identify and distinguish different affective characteristics in different levels within human-computer interaction regarding usability and accessibility.

This document identifies a range of affective characteristics that are designed for development of affective computing. This can be a general principle for affective computing user interface. It also provides references to the selection of specific characteristics of particular interest, and to the identification of affective characteristics in affective computing user interface (AUI).

Information technology — Affective computing user interface (AUI) —

Part 2:
Affective characteristics

1 Scope

This document identifies the affective characteristics for affective computing user interface (AUI), including universal, cultural, individual and situational issues relating to the affective needs of users. This document also describes the selection criteria of these affective characteristics, and the methods to identify or apply them.

This document focuses on developers of affective computing user interfaces who want to meet the needs of users.

This document does not specify the implementation of affective computing.

2 Normative reference

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
affective characteristic
particular type of affect that is believed to be useful

Note 1 to entry: A complex compound of interests, attitudes, and self-views. Affective characteristics are considered as properties that are used to describe users' affective experience in AUI.

[SOURCE: ISO/IEC 30150-1:2022, 3.3, modified — A note to entry has been added.]

3.2
affective
relating to moods, feelings, and attitudes

3.3
satisfaction
extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations

[SOURCE: ISO 9241-11:2018, 3.1.14, modified — Notes to entry have been omitted.]

3.4
cognition
mental actions or processes of acquiring knowledge and understanding through thought, experience, and the senses

[SOURCE: ISO 21801-1:2020, 3.2]

4 Organizing affective characteristics

This document organizes affective characteristics in terms of how broadly they apply:

a) Universal – relating to all users

b) Cultural – relating to well-defined groups of users

c) Individual – relating to single users, combining to make each user unique

d) Situational – relating to a single user only in some situations

The organization of this document is one possible way of identifying and organizing affective characteristics. There are many other possible groupings of affective characteristics, and this grouping has been chosen because it clearly distinguishes between emotions (which are situational) and other major types of affective characteristic.

This document focuses on a selection of characteristics that are particularly likely to be dealt with in affective computing applications, but that there are many other possible ones that can also be used.

Affective characteristics are considered in the affective domain. Both the affective domain and the cognitive domain are related to affective computing applications, see Annex A.

Clauses 5 to 8 describe universal, cultural, individual and situational affective characteristics, respectively.

5 Universal affective characteristics

5.1 General

Universal affective characteristics refer to affective characteristics that affect all people equally and at all times. These characteristics are based on human needs and can be identified and treated in a similar manner for all users.

5.2 Hierarchy of human needs

According to Maslow's hierarchy of needs[5], there are a set of affective needs that are shared by all humankind, including:

a) Physiological needs: the needs for basic physical stability by the provision of food, clothing, shelter and other basic physical needs.

b) Safety and security needs: the needs to ensure that a person will continue to have their physiological needs met and that they will be free from threats of harm.

c) Belonging needs: the needs for the individual to have family and friends.

d) Esteem needs: the needs for receiving the esteem of others, having self-esteem, and even providing esteem to those others who have earned it.

e) Self-actualization: the needs for realizing personal ideal and ambition and giving full play to personal ability.

Maslow assumed a person's needs can be satisfied at lower levels before a person will concentrate on meeting needs at a higher level. But this trend of needs is not completely fixed, it can change under different circumstances. Individual differences in the level required to satisfy an individual's needs occur between different users.

5.3 Human needs and application designs

5.3.1 General

The designers and developers can take considerations in users' needs and motivations involving in a certain system or application.

5.3.2 Application designs for each level of needs

Physiological needs can disrupt computing processes, which cannot readily be predicted for most users. The guidance for designers and developers is that tasks can either be short or easily interruptible so that users can attend to physiological needs when they arise.

The need for safety and security demands designer to seek and prevent potential threats of applications from users, which can cause anxiety and feelings of inadequacy.

The users unsuccessful in achieving sense of belonging usually turn to new groups. Social applications and systems that provide groups and communities can help these users fill the need of belonging with inner communications and mutual commitments.

Esteem usually can be receiving within the systems or applications from users themselves or others. Apps and web sites can use the need for esteem to motivate users by means of communication tasks that can provide opportunity for users to increase esteem from others and tasks that can help users succeed in completing to increase self-esteem and avoiding decreasing self-esteem.

Self-actualization involves being fulfilled and doing what one "is fitted for". Apps and websites can avoid attempts at faking motivations that might appeal to self-actualized people, since they are likely to discover the fakes anyhow. Rather, apps and websites will find that honest disclosure of intent and providing quality content that meets widespread needs will be most motivating to self-actualized people.

5.4 Applying hierarchy of needs

Even though the needs in the hierarchy can be in different levels, some activities in a lower level can also satisfy some higher-level needs. The overlap of different levels of needs and motivations can help find the substitutes for other activities or designs.

The hierarchy of need is also important in its concept of satisfaction of specific motivations and needs. It suggests that individuals determine unique levels at which they consider a need to be satisfied. There is little or no motivation for them to go beyond that level. This same relationship holds true for functionality and usability. Users will shift their attention from functionality to usability once a basic level of functionality is achieved. They might again shift their focus once a basic level of usability is achieved to more specific motivations. At this point, further changes cannot be allowed to bring either factor below its basic required level.

6 Cultural affective characteristics

6.1 General

Culture is a set of customs, traditions and values shared by members of a society, community, organization or other groups. Cultural issues relate to well-defined groups of people at all or most times. Cultural issues affect large groups of people (at all or most times) and are different for different groups of people.

6.2 Cultures as a source of belief and action

Cultures teach their members beliefs and methods/actions of responding to a variety of situations. While these beliefs and actions are generally based on widespread experience of members of the culture, they can be as dependent on the affective experiences as they are on the factual experiences of those members. These beliefs and actions are shared among the members.

It is difficult to try and evaluate these characteristics (loyalty, susceptibility, conformity, obedience to authority) because individuals can have and apply these characteristics at either a public or private level. These characteristics can vary depending on the particulars of a given situation. It is easier to evaluate the potential consequences of individuals acting on the beliefs and with the methods of different groups.

6.3 Recognizing the effects of cultures

There are two basic approaches to recognizing the influences of a culture on an individual: an exclusive approach and an inclusive approach.

The exclusive approach assumes that one culture will always take precedence over another culture. Given a situation, response can be made by individuals based on the beliefs and methods exclusively from user groups, dominant social group, personal experience and other social groups in sequence.

The inclusive approach requires that each social relationship of individuals can and may affect the responses of an individual to a given situation. It also recognizes that different cultures will take precedence, intentionally or unintentionally, at different times. Actual precedence is based on the importance of the current relationship to the task and the importance of relevant beliefs from that culture to the individual.

6.4 Cultures and designs for user interfaces

The major types of cultures include family relationship, ethnicity and nationality, religion, professions, business relationships, organizational relationships, and casual relationships.

The types of cultures indicate similarities, diversities and needs of certain groups of people. Considerations can be taken once the cultures that users involve have been recognized.

Membership in a family generally develops over a long period of time with loyalties and expectations. Family affiliations can be considered in the design of many applications and websites. Social computing applications can be performed in a family setting or for family purpose. Users cannot be made to choose between their loyalty to their families and loyalty to another social grouping.

Ethnicity and nationality mean different values, myths and laws, which regulate the members in some manners, reflecting the certain symbols and taboos. Once the ethnicity and nationality are recognized by designers and developers, the systems and applications can follow the rules of conducts of certain ethnicity and nationality.

The designs of application concerning religions are similar to that concerning ethnicity and nationality. Additionally, the religious controversies and denominational biases can be avoided due to the religious culture.

Various professions and occupations have developed their own cultures to deal with issues within their "professional" scope of interest. These cultures can act similarly to how ethnic and national cultures act, and due to their large number of members can be treated in a similar manner.

There are an infinite set of possible business relationships, organizational relationships, and casual relationships that can provide cultural effects on individuals. However, like families, their large number of members makes it infeasible to utilize these relationships in affective computing.

6.5 Group characteristics related to cultures

6.5.1 General

There can be a considerable overlap between characteristics of groups and cultures of the individuals who are members of these groups. Individual members of groups can be more willing to discuss these characteristics of groups than their own cultural characteristics, even where these cultural characteristics are reflected in themselves. It is useful to consider the influences on individuals from both the cultures and groups, and to further consider the characteristics that uniquely affect groups.

There are a variety of characteristics that describe influences of groups on individual members of a group.

6.5.2 Characteristics of groups and application designs

Individuals are simultaneously members of a number of identifiable groups, however, at any time, there is likely to be one group whose influence predominates over all the others. It is impossible to design for all possible groups and their influences. The characteristics of groups can be organized into membership, self-concept, orientation and relations.

A human group is a collection of individuals. Membership can be acquired once the user is in a certain group. Group criteria can be available to users for the purposes of joining, maintaining, and terminating membership. Belief and norms can be supported for communication and interaction does not result in stifling the very communications and interactions it sets out to support. Designing for flexibility and responsiveness in these support systems can help them to be usable not only at the present but also in the future. Group cohesion can benefit from good design in unique group symbols, good communication of objectives, status reports, other pertinent group information, group support services, as well.

A group's self-concept of its identity provides the reason both for its existence and for the actions of its members. Self-concept can be divided in temporal terms: past concepts, present concepts and future concepts. The past concepts usually help designers find collective values, traditions, myths, successes and failure of the group. Developers can use current integration and differentiation as a basis for designing future integration and differentiation. The future concept of a group refers group goals, long range plans, or mission statements. Developers can balance the failure and success when developing for a group of people, making corresponding actions to make the project undertaken or terminated.

Groups can often be characterized as having certain orientations based on a number of general trends that the group exhibits. Rather than being totally deterministic, these trends suggest that a group is more likely to act in certain manners than in others.

Relations involve a number of general interactions between the group and individuals. While these general interactions are relevant to all groups, how they are implemented for a given group can vary considerably. The specifics of these relations and interactions can affect both individuals and groups in a variety of ways. Some of the important group relations that can also be considered: power, independence, interdependence, permeability, coordination, communication.

6.5.3 Trade-offs of characteristics

These characteristics of groups involve a number of trade-offs: within themselves, with each other, and with other characteristics. Trade-offs with each other and trade-offs with other characteristics often only become apparent when they result in conflicting design guidance. Where conflicts occur, they have to be resolved either by determining precedence of needs or by attempting to accommodate both sets of needs. The characteristics of groups generally interact with the other characteristics of an individual in varying combinations. In the extreme (which is unfortunately often what is designed for) they can take precedence over individual characteristics. They can affect all aspects of task accomplishment, including even the definition of the tasks themselves.

7 Individual affective characteristics

7.1 General

Individual issues are those recognized as differentiating individuals from various cultures and other groups to which they might belong. Each individual can be considered in terms of all these affective characteristics, and the value of each characteristic can differentiate them from other individuals. The following characteristics are chosen for their availability.

7.2 Personality

Personality is the combination of characteristics or qualities that form an individual's distinctive character. The choice of user and of user groupings directly relate to one's personality. Because people in a same group have similar personalities, they will respond to many situations and problems in similar ways, and they will create characteristic interpersonal environments. Common personality types, shared within a user group, can have significant effects on the usability of a given system by members of that user group.

While personality can be available for some selected occupational groups, it is seldom available for most groups that would be directly relevant to the design of most applications or websites. The alternative is for an objective developer or other evaluator to compare a set of characteristics of the different personality types with known traits of the members of each group.

7.3 Attitudes

Attitudes refer to learned predispositions to respond in a consistently favourable or unfavourable manner with respect to a given object. Attitudes often influence the performance or preference internally and are difficult to recognize. However, attitudes can often be inferred from the analysis of the words or actions either by individuals or by groups. The attitude for an object can be analysed in three dimensions of affective meaning:

— **Evaluation** (good/bad) – This is the most prominent component and most directly applicable to measuring attitude.

— **Potency** (strong/weak) - This gives an indication of the relative importance of the attitude to the individual or group and the potential that the attitude will influence their actions.

— **Activity** (active/passive) - This is the least important of the three dimensions with regards to attitude and has the least relationship to issues of application and web design.

Attitudes can influence a user's general approach to a task that can in turn influence the resulting success with the task. Attitudes can also be transferred from known objects to unknown objects.

7.4 Beliefs

Beliefs deal with information a person has about something or someone. Beliefs have both objective and subjective bases. It is important to recognize that an individual's beliefs will differ from the beliefs of others to some extent, even from those others belonging to the same culture(s). People who share a common belief often differ in their strength of that belief. Care can be taken that users do not feel threatened for having held beliefs that are no longer considered "correct" or "appropriate". This might require focusing on the advantages of changing beliefs, while recognizing and respecting that they are new to the user.

7.5 Achievement motivation

Achievement motivation is an important determinant of aspiration, effort, and persistence when an individual expects that his/her performance will be evaluated in relation to some standard of excellence.

Once a task has been chosen, achievement motivation can be combined with rewards to help insure its completion. Users, in fact, need to be motivated in everything they do, and require a deeper understanding of what actually motivates individual user groups.

7.6 Risk taking/aversion

Risk taking/aversion is the practice of taking action which might have undesirable consequences. A person's risk taking/aversion depends on their perception of the frequency and severity of negative consequences and their perception of the benefits of proceeding. Risk taking (and the sense of adventure often associated with it) is an example of one of the many specific characteristics and behaviours that can have important design consequences for computer software, including:

— setting a general tone of either adventure or stability;

— choosing between mimicking the familiar and attempting to be original;

— the level and type of instructions, user guidance and tutorials required to support the users;

— the size of chunking of activities and of their accompanying risks.

8 Situational affective characteristics

8.1 General

Situational affective characteristics are those that occur only in some situations and are subject to change with the changes of situations. The values of situational affective characteristics are often more useful as indicators of what has just happened than as predictors of what can happen. Situational affective characteristics usually refer to emotion.

8.2 Transient nature of emotions

There are many more particular emotional capabilities that people often develop based on a combination of their personalities and their lifetime experience. Emotions can and do change based on the current context of use of an individual. Thus, emotions are a better determiner of the user's present affective state rather than their overall affective characteristics.

8.3 Emotions, satisfaction and user experience

According to ISO 9241-11:2018:

— "Emotional responses represent affective components of satisfaction."

— Satisfaction is defined as "extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations".

— Satisfaction is one of the three components of usability, which is defined as "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use".

— Satisfaction is related to user experience, which is defined as "user's perceptions and responses that result from the use and/or anticipated use of a system, product or service".

8.4 Emotions and context of use

ISO 9241-11:2018 treats satisfaction (including emotional responses) as the outcomes of using system within a context of use. The "context of use" is defined as "combination of users, goals and tasks, resources, and environment", which recognizes that satisfaction and the emotions related to it can change readily based on changes in the context of use.

9 Identification of affective characteristics

9.1 General

Individual affective characteristics are not useful unless a computer can identify the value of that particular affective characteristic for a particular user.

9.2 Time frame of identification

The amount of time taken to identify the value of an affective characteristic will have a considerable impact on the accuracy of the value.

— Instantaneous: a single value can not suffice to correctly interpret what the value means.

— Current session: small amounts of identified data could lead to very different interpretations.

— Long term profiling: the most accurate identification of the values of different affective characteristics as accuracy will be improved from the collection, combination and analysis of data.

9.3 Methods of identification

9.3.1 General

Affective characteristics are usually embedded in different affective-related data in different forms. Affective-related data can be identified within a computing system using the following methods.

9.3.2 Physiological identification of affect

In the process of interaction, various types of physiological signals indicate or reflect the affective characteristics of a certain user. The values of these physiological signals can be identified through different modalities of affective-related data.

Specifically, physiological signals can be detected in visual, auditory, tactile/haptic and neurophysiological modalities. The choices of modality can be one of them or combined depending on the context of use and equipment. Once the values of these affective-related data have been calculated, the affective characteristics can be identified to be further processed.

Vision (including computer vision) can detect emotions and other affective characteristics involved in eye contact, facial expression, body language and gestures.

Hearing (including computer analysis of sound) can detect emotions and other affective characteristics involved in tone of voice, loudness/intensity of voice, other aspects of prosody and non-verbal sounds.

Tactility can detect emotion and other affective characteristics involved in: TextTactile, vibration, force feedback, etc.

Neurophysiological signals can reflect emotion and other affective characteristics involved in electrocardiogram, respiration, electromyogram, galvanic skin response, blood pressure, etc.

In addition to the identification of instantaneous signals, timing of the duration of the signals and of the delay between system actions and the user responding with these signals can be used to further analyse these signals.

9.3.3 Questions to the user

There are a range of attitude, personality and other tests that are used in psychology, which can be acquired via questions. The questions can be focused on identifying the needs and preferences.

Users are often willing to answer questions about their needs and preferences, especially where small numbers of questions are asked in the context where they can be applied, as opposed to asking large

numbers of questions within an initial setup of the system for the user. Answers about individual needs and preferences can be analysed to suggest underlying affective characteristics, which can, in turn, be used to predict other needs and preferences, which, then or at a later more appropriate point in time, can be suggested to the user for confirmation.

9.3.4 Inferring from user customizations

The information can also be obtained from customization settings that are available to the user whenever the user wants to access them.

The methods of customization differ in system: initial setup and customization within context. Initial customization settings are often more guesses than accurate expressions of a user's needs and preferences for interacting with a particular system. The more appropriate time to do customization is within the context where it would help. In this method, users can provide person experience in this context, which make it acceptable.

9.3.5 Inferring from user actions

Computers provide users choices of what they want to do. Most user tasks have a variety of ways that they can be performed. Good software usually provides users with alternative ways rather than forcing them to use a single way. A user's choice of how to proceed with a task can help identify some user needs or preferences.

While this approach will be limited if the system does not provide enough options, it can be used along with other methods to better identify a user's affective characteristics than might be done using the other method alone.

9.3.6 Inferring from user vocabulary

The words that people choose to use contain both cognitive and affective meanings. People choose the words they use in their communications both consciously and unconsciously. This choice is determined by both the cognitive and affective characteristics of what they are trying to communicate.

9.3.7 Inferring by association

Patterns of behaviour are analysed by social media and marketing organizations to predict various things about a user (including characteristics, attitudes, etc.). This includes using information on their friends, likes, purchases, searches, and even the search results that they look at to make inferences from one user to another.

Annex A
(informative)

Affective and cognitive domain

A.1 General

Cognitive is related to the developments of knowledge and understanding in the mind, and affective is related to moods, feelings, and attitudes.

There is an overlap in the functioning of cognitive and affective processes in humans. Picard et. al.[20] recognized this overlap in their manifesto on affective learning, "The use of the computer as a model, metaphor, and modelling tool has tended to privilege the 'cognitive' over the 'affective' by engendering theories in which thinking and learning are viewed as information processing and affect is ignored or marginalized. In the last decade, there has been an accelerated flow of findings in multiple disciplines supporting a view of affect as complexly intertwined with cognition in guiding rational behaviour, memory retrieval, decision-making, creativity, and more. It is time to redress the imbalance by developing theories and technologies, in which affect and cognition are appropriately integrated with one another."

A.2 Cognitive issues related to affective computing

A.2.1 General

While this document focuses on affective characteristics, it is important to identify cognitive issues that might result in affective responses.

A.2.2 Reasoning

There are large differences between users in their preference for and ability to use different reasoning processes.

Less experienced users will tend to favour use of the same single process in almost all situations and become frustrated or worse if they cannot apply their favoured process (due to the organization/design of a system or to the unavailability of some information they need). More experienced users will use contextual knowledge to choose the most appropriate process and might even try multiple approaches.

When complex reasoning is involved, providing support for different types of reasoning can be important in achieving satisfaction.

A.2.3 Problem solving and decision making

Problem solving and decision-making go beyond the reasoning of new information to get the user responds to this information. This can involve adapting the information we have to deal with new situations.

There are many different theories of problem solving and decision making:

— some rely on various forms of reasoning and logic

— some are based on life cycles (similar to the systems development life cycle)

— some attempt to identify the role of creativity and other subjective concepts

Many individual theories have primarily been studied within limited, task specific domains. Little is known about problem solving and decision making that can be applied to the analysis of and design for user groups. Anecdotal and historical evidence of problem solving & decision making might lead to particular insights