Chapter 4

ANN Based Approach to Integrate Smell Sense in Multimedia Systems

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ABSTRACT

Despite the wide usage of multimedia in several applications, research in the field of olfaction is immature in helping humans work and communicate through multi-sensory interfaces, including smell. There is no consistent method of testing user capability of smell. Therefore, smell detection and generation systems are not well integrated into today’s multimedia systems. In this paper, the authors propose an odor sensing system with the capability of the discrimination among closely similar 20 different odor patterns and propose an on-line classification method using a handheld odor meter (OMX-GR sensor) and neural network that can be used in different multimedia applications. The proposed system is integrated to enhance the functionality of an online multimedia shopping system that is capable of selling products with visual and auditory senses.

1. INTRODUCTION

The Multimedia systems are widely defined as Multi Sensory systems that convey information about the current state of the real world environment by congregating signals from several receptors in the ears, eyes, and other sense organs. The signals from one side of the body are sent through nerve fibers to the cerebral cortex on the opposite side of the brain, where they are perceived and interpreted in terms of our previous experiences, knowledge, and expectations. The

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five well known physiological systems that lie at
the core of the human perceptual experience are
Olfactory (smell), tactile (touch), visual (sight),
auditory (sound), and perception of flavor (taste).
Nonetheless, extensive research has been carried
out to develop multimedia systems that can cap-
ture, store and reproduce sound and video with
high quality (Paeda et al., 2008; Pfeiffer, Lienhart,
& Efflsberg, 2001). However, there are the other
three senses, smell, touch and taste that received
less attention within the multimedia research area.
These senses, in addition to sight and sound, can
recreate an environment similar to the real world
environment in particular the smell sense. This is
because amongst the three other senses the smell
is the only sense that can be perceived from a
long distance.
Nonetheless, few odor-sensing tools have been
proposed in limited applications. This is because
of the complexity on designing olfactory system
that can perceive different smells for humans with
a variety of preferences. Table 1 presents some
of these limited applications from the literature.
However, these systems are barely designed
to fit on the industrial applications to reduce the
cost of productions or prevent risks and hazards
when handling toxic gases. Therefore, the imple-
mentation cost for these aforementioned olfac-
tory systems is irrational for multimedia systems.
In this paper, therefore, we present the design of
a low cost odor system that can be employed in
a multimedia environment. The odor system
proposed in this paper has employed the Artificial
Neural Network (ANN) technique of humans
brain to discriminate amongst different smells.
The organization of the paper is as follows: Sec-
tion 2 presents a brief description of the human
olfactory system and Section 3 provides a sum-
marized overview of ANN techniques. Section 4
presents a justification of the ANN usage in smell
sensors. The proposed system is presented in
Section 5. The performance evaluation and con-
clusions are presented in Sections 6.

2. MODELS OF THE
OLFATORY SYSTEM

The goal of much of the research regarding the
olfactory system is to understand how individual
odors are identified. Many researchers have
produced mathematical models of the olfactory

<table>
<thead>
<tr>
<th>Application</th>
<th>System Specification</th>
<th>Year</th>
<th>Authors</th>
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<tbody>
<tr>
<td>agricultural</td>
<td>Single coated thermistor as the odor sensor</td>
<td>1961</td>
<td>(Moncrieff, 1961)</td>
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<tr>
<td>smell detector</td>
<td>an array of eight electrochemical sensors</td>
<td>1964</td>
<td>(Wilkens &amp; Hartman, 1964)</td>
</tr>
<tr>
<td>Electronic nose</td>
<td>pattern recognition techniques</td>
<td>1994</td>
<td>(Gardner &amp; Bartlett, 1994)</td>
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<tr>
<td>polymer gas sensors</td>
<td>an integrated circuit based device that performs data acquisition from a miniature array of 32</td>
<td>1994</td>
<td>(Hatfield, Neaves, Hicks, Persaud, &amp; Travers, 1994)</td>
</tr>
<tr>
<td>An Intelligent E-nose</td>
<td>of measuring signals from arrays of resistive and piezoelectric sensor types in the same board</td>
<td>1997</td>
<td>(Dyer &amp; Gardner, 1997)</td>
</tr>
<tr>
<td>Robot head that reacts to some smells</td>
<td>A recognition algorithm that uses a look-up table that contains sensor outputs and their derivatives</td>
<td>2001</td>
<td>(Miwa, Umetzu, Takanishi, &amp; Takanohu, 2001)</td>
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<td>chemical industry to detect toxic gases and gases without smell</td>
<td>The sensor electronics is based on a scanning version of a vibrating capacitor (Kelvin probe)</td>
<td>2002</td>
<td>(Li &amp; Hopfield, 1989; Mizsei &amp; Ress, 2002)</td>
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