Evaluating the use of Emotion Recognition Technology (ERT) for consumer sentiment analysis in marketing

Michal Pluta

14 + 407 + *(653)* + 118 = 539/1650 words

***Abstract*— In this paper we discuss the ethical considerations necessary for an emotion recognition system used for dynamic ad placement to exist. We perform an Ethical Impact Assessment using the Value Sensitive Design framework, and offer recommendations to ensure the system is implemented with minimal underlying bias.**

1. Introduction

The first impression a consumer forms upon encountering an advertisement (ad) plays a pivotal role in determining its success in engaging their interest [1], [2]. By understanding how consumers emotionally connect with advertisements, agencies can make informed decisions to improve the effectiveness of their marketing. This underscores the importance of gathering and analysing data on consumer sentiment.

The proposed solution is a machine-learning model capable of classifying facial expressions into distinct labels. The model will consist of 3 key mechanisms:

1. *Object detection & classification* - Identifying and distinguishing human faces within a visual input
2. *Gaze detection* - Detecting which people are currently looking at the advertisement
3. *Emotion classification* - Classifying the facial expression

The model will be trained, validated, and tested using a large, diverse range of human faces each labelled with an emotion. For an in-depth discussion of dataset choice and recommendations for implementation see Section 7.2.

The primary output of the model is an emotion distribution, indicating the model's confidence level in each emotion, similar to that depicted in Figure 1 below.

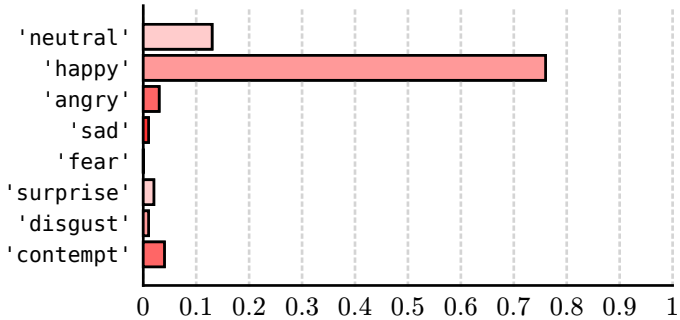

Figure 1: Sample model output distribution [3]

2. Applications of the system

While this system has a variety of potential uses in marketing, for example:

- *Market Research* - Analysing consumer sentiment in a product's development phase, to make small adjustments to the product.
- *A/B testing* - Presenting two versions of a product to a candidate, and measuring which one they react more positively to. This is particularly applicable to websites where most have roughly 5 seconds to make a lasting impression [2].

, we will focus on *Dynamic ad placement.*

In particular, consider high-traffic pedestrian areas such as bus-shelters, train stations, or public squares which are littered with advertising screens.

Figure 2: Example of an advertisement at a bus-shelter [4]

By leveraging emotion recognition and continously surveying the general public through video feeds, advertising agencies may:

- Identify which ads are most well received in which areas
- Switch the displayed ad for a passerby if it detects a negative response to the currently shown ad
- Sell this data back to brands

3. Value Sensitive Design (VSD)

- Why Ethical impact assessments are useful/necessary
- Summarise Value Sensitive Design approach
  - Description, why it is beneficial/appropriate

VSD is an approach to system design that systematically integrates human values into the design of technology [5]. It relies on an *"iterative, tripartite methodology consisting of conceptual, empirical, and technical investigations"* [5], [6].

More broadly, it is a methodology that seeks to identify stakeholders' root values [7], how values of these stakeholder groups may conflict, and offer compromises or ways to resolve those conflicts in an unbiased way.

4. Immediate Ethical Issues

- Highlight any apparent ethical issues to be considered ahead of development

Two immediately apprarent ethical issues are:

1. **Informed consent** [5]
2. **Environmental sustainability**

5. Ethical Impact Assessment

Stakeholder	Values	Potential risks / harms
Advertising Agency (Direct) Serves as the project initiator and aims to collect data on individual's first impressions to advertisements and leverage machine learning algorithms to optimise location, timing, and content of ad placements.	1. **Accuracy** Ensuring the data collected on people's immediate reactions to advertisements is accurate is vital to understand the true impact of the ads. 2. **Accountability** The agency must be held partially or fully accountable for the technology's use, and potential misuse and consequences. 3. **Innovation** Advertising is a highly competitive and constantly evolving landscape. By developing new technologies, the agency can uncover insights that competitors cannot, giving it a competitive edge in the market. 4. **Consumer Engagement** Engaging consumers effectively is crucial for the success of every advertisement [8]. Higher consumer engagement leads to a boost in consumer loyalty, higher consumer retention [8], and ultimately higher conversion rates [9].	In recent years, Data-Driven Decision Making (DDDM) has seen increased adoption to help organisation reduce risk and take advantage of opportunities. It does however have its downfalls where faulty data can lead to disaster as was the case with the 2008 financial crisis where many data-driven models had hard-coded incorrect data. [10]
Brands (Direct) Companies who approach the advertising agency with a product to advertise to the general public.	1. **Consumer Trust** The trust consumers have in a particular brand is directly correlated to their likelihood of purchasing products from that brand [11]. Moreover, given that the likelihood of converting an existing customer ranges from 60-70%, compared to only 5-20% for new customers [12], it is clear brands will ensure consumers stay loyal.	
Developers (Direct) Employed by the advertising agency and tasked with creating the technology.	1. **Universal usability** Developers are likely to prioritise usability by ensuring the technology is accessible to the widest possible audience, including individuals with disabilities, and people from a diverse range of backgrounds. 2. **Freedom from bias** Valuing freedom from bias directly influences the integrity and fairness of the technology. This responsibility is	

Stakeholder	Values	Potential risks / harms
	particularly significant given the increasing regulation around data ethics and AI fairness [13] 3. **Quality product** The value placed on delivering a quality product/solution is closely linked to a developer's professional pride and technical reputation. Additionally, for developers it is clear that if the implemented system matches or goes beyond expectations their career prospects can improve significantly.	
Consumers / Data Subjects (Indirect) Members of the general public who are	1. **Autonomy** Within consumer choice contexts, autonomy is viewed as "(the) ability to make and enact decisions on (your) own, free from external influences" [14]. By allowing consumers to make independent choices that align with their personal preferences, needs, and values, they may experience higher levels of satisfaction. 2. **Relevant / Personalised ads** Enables ads to cater to specific interests making the shopping experience more efficient and enjoyable. Reduces the amount of irrelevant advertising noise and makes the experience feel tailored to the consumer.	
Privacy advocates (Indirect) Organisiations or activist groups advocating for the general public's privacy rights	1. **Privacy** These organisations consider privacy as a cornerstone of individual freedoms and societal well-being, consequently, they actively confront development of technologies that encroach upon human privacy [15].	
Government, Regulatory bodies, and policy-makers (Indirect) Organisations regulating the development and usage of AI and facial analysis systems	1. **Human Welfare** Governments have an ethical duty to ensure the well-being of their citizens, promoting policies that protect the vulnerable and support society as a whole. By prioritising welfare, it ensures social stability, avoiding social unrest. This is most commonly achieved by heavily regulating new technologies [16] and discussing pressing issues with a level of transparency [13]. 2. **Courtesy**	AI uses power May backfire and government may be scrutinised for not interfering and stopping this technology

Stakeholder	Values	Potential risks / harms
	Governments should be courteous in public course to promote a cooperative, respectful environment essential for democratic processes and effective implementation of policies. 3. **Environmental sustainability** Governments have an ethical and moral obligation to ensure companies act in an enivornmentally sustainable way such that inter-generational equity is not affected.	
Competitors (Indirect) Competitors of the advertising agency.	1. **Innovation** 2. **Accuracy**	
General Public (Indirect)	1. **Informed consent** 2. **Privacy**	

Table 1: Ethical Impact Assessment using VSD

6. Value Conflict Analysis

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7. Recommendations

- Guidance on data collection and preparation, task design, or task deployment
  - Technical and Non-technical Recommendations
- Utilise existing AI ethics frameworks and bias mitigation toolkits

1. *Motivation for recommendations*
2. *Choice of Dataset*
   - Where is the documentation
   - Who is included? How is is sampled? Does the distribution align with the population the algorithm is applied to?
     - If the advertising solution is outsourced to other countries or locations then the target demographic may not be the same as the one that trained the ML
   - What data is collected
3. *Risk and bias mitigation measures*
4. *Critical Assessment and Limitations*

While VSD is well-tested, it is a theoretically grounded [5] approach which does not provide a clear way of embedding values into the design [7].

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