

Human Computer Interaction

**Head Movement Detection Techniques and
Emotion Detection in cars**

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Introduction

- Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.
- HCI concerned with
 - Methodologies and processes for designing interfaces.
 - Methods for implementing interfaces (e.g. software toolkits and libraries; efficient algorithms).
 - Developing new interfaces and interaction techniques.

Design Principles and Design Methodologies

- Early focus on user(s) and task(s): Establish how many users are needed to perform the task(s) and determine who the appropriate users should be; someone who has never used the interface, and will not use the interface in the future, is most likely not a valid user.
- Activity theory: used in HCI to define and study the context in which human interactions with computers take place. Activity theory provides a framework to reason about actions in these contexts, analytical tools with the format of checklists of items that researchers should consider, and informs design of interactions from an activity-centric perspective.

Possible ways for Human Computer Interaction

Human can interact through

- Pressing a key
- Performing a Gesture
- Speech command
- Head and Body movements

Head Movements

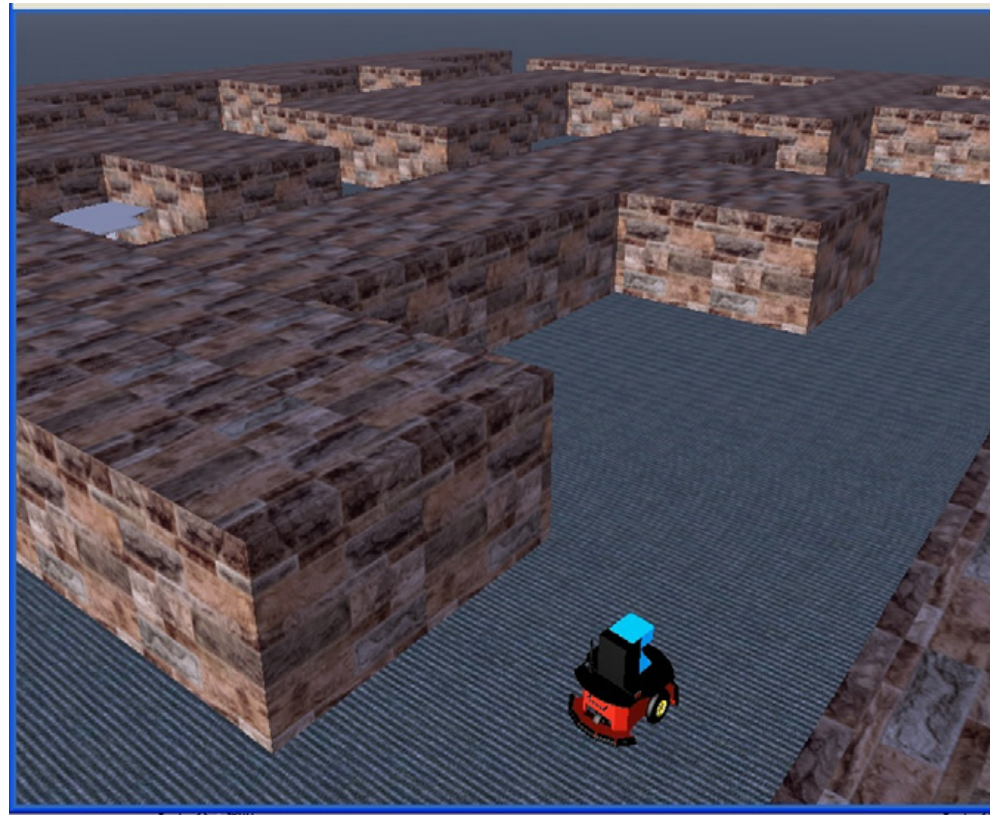
- Human beings naturally express their attitudes by using head movements.
- As one of non-contact human–machine interaction techniques, headpose recognition has very wide-ranging applications such as auxiliary driving systems e-learning , visual user interface, virtual mouse driving , intelligent environment, intelligent wheelchair systems and robot systems .

System architecture

- Software Environment: Microsoft Robotics Developer Studio
- The system firstly uses Adaboost classifiers for detecting the Face from the image and after roughly it identifies the head pose as Left and Front0.
- Purpose: Microsoft Robotics Developer Studio is used to construct a virtual scene in which a small robot can walk in a maze controlled by the head poses.

System Architecture

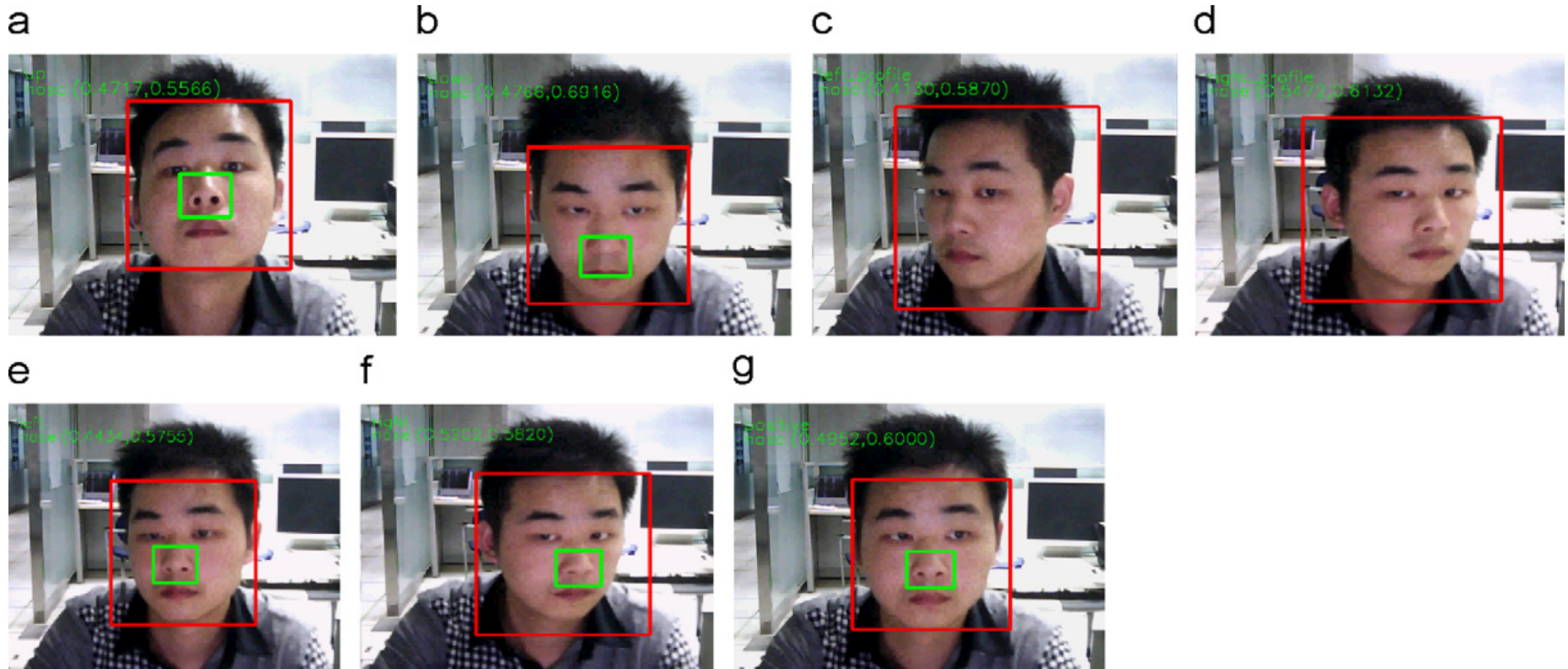
- Information Processing and operating
- Virtual robot and Maze Environment.



Head Pose Detection

- In this system, the virtual robot will be controlled to move in a virtual maze scene according to 7 different head poses.
- They define seven head poses for this application:
UP, DOWN, LEFT, RIGHT, H-LEFT, H-RIGHT, FRONT.
- which respectively correspond to the commands that control the robot to go forward, backward, turn left, right, half-left and half-right, and stop.

Head Pose Detection



Head Pose Detection

- If the first result is FRONT0, then two approaches are proposed to further recognize FRONT0 as UP, DOWN, H-LEFT, H-RIGHT or FRONT1. Then two approaches for head pose detection.
- The first approach adopts PCA(principal component analysis) and nose template matching to recognize as specific headpose.
- The second approach directly utilizes nose's relative position information in the face region to achieve this purpose.

Results

- Both Approaches are comparable time consumed.
- but the second approach provides more correct results. The reason is that when a head moves within a smaller range, that is, the nose is within the face's region, the nose's relative position in the face region is able to perfectly express the change of the headpose, especially for the headpose UP and DOWN.

Emotion Detection in Cars

- Automatic emotion detection and affective computing provides a promising basis for future-oriented human-computer interaction (HCI) in cars.
- A new non-invasive method to detect positive(happiness) and Negative(Angry) emotions in an automobile context using grip- strength applied on the wheel.

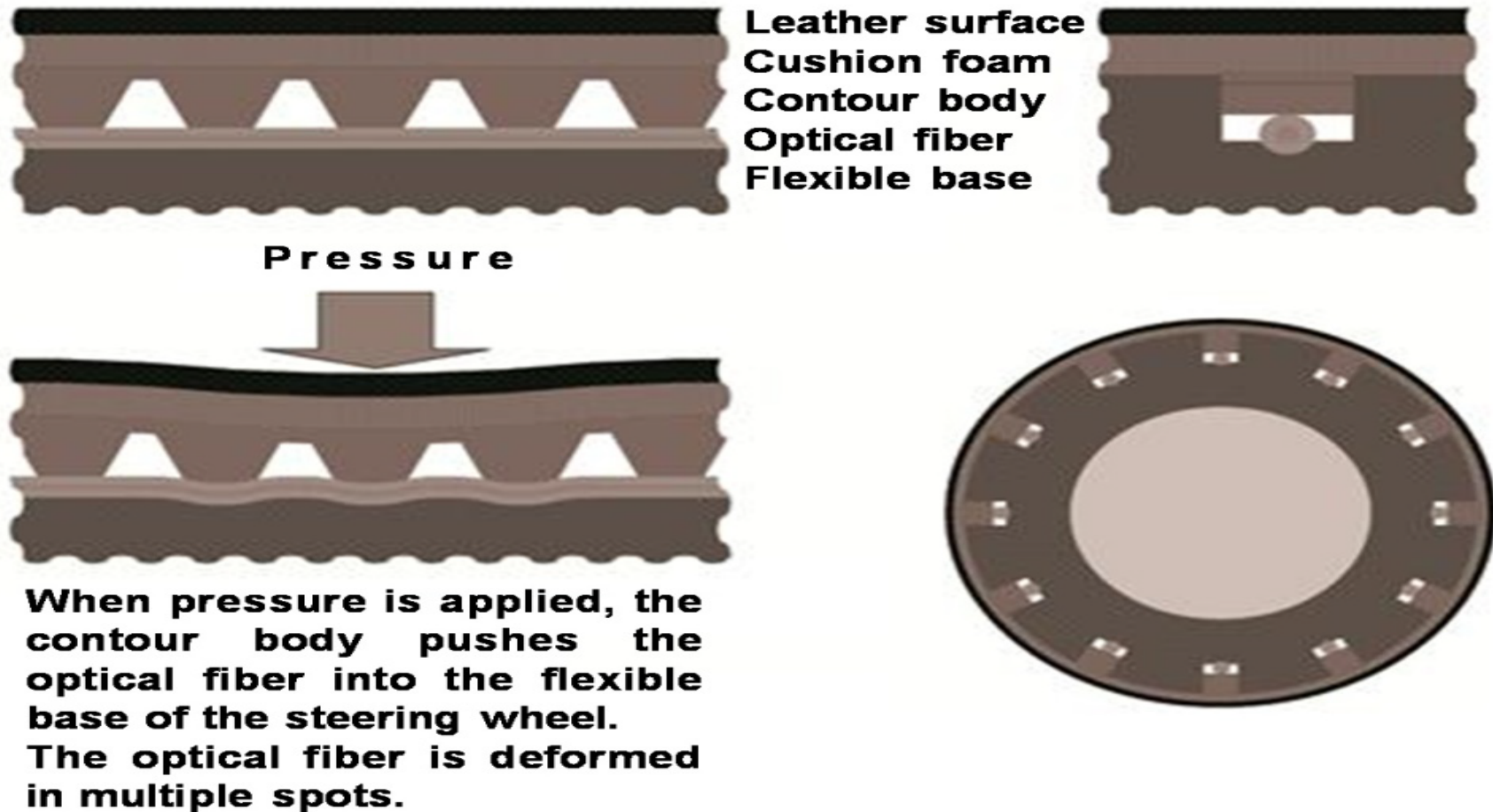
Methodology

- The driver's grip-strength applied to the steering wheel can constantly be measured, between different emotional states.
- As additional non-invasive measurements, sitting posture and variation in the accelerator pedal were recorded.
- Variation in the position of the accelerator pedal has been linked to high mental workload and could therefore correspond with high emotional arousal.

Methodology

- This study was based on a one-factorial design with repeated measurements. The independent variable was the induced emotion in the driver. The induction was between-subjects three-tiered in neutral vs. anger vs. happiness. The dependent variable was drivers' grip-strength applied to the steering wheel.
- To measure grip-strength in this experiment, they used a unique steering wheel provided by the KOSTAL Group. The steering wheel had a built in fiber that measured deformation caused by force applied on the steering wheel by participants' hands.

structure of the grip-strength sensitive steering wheel



Results

- The grip-strength can contribute to the detection of emotion.
- Grip-strength measures were slightly but not significantly increased for the happiness group.
- They observed a comparable increase as well for the neutral condition.
- A significant decrease in grip-strength for the anger condition.

References

- Using head poses to control a virtual robot walking in a virtual maze Qingjie Zhaon, Weicun Xu, Yuxia Wang, Xiaoming Shi.
- Improving Human-Machine Interaction – A Non Invasive Approach to Detect Emotions in Car Drivers Michael Oehl, Felix W. Siebert, Tessa-Karina Tews, Rainer Höger, and Hans-Rüdiger Pfister.
- Head Pose Estimation in Computer Vision: A Survey
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Thank You