Analysis of facial features and impressions, computerized facial caricature artists, facial expression recognition, facial similarity search, human-robot interactions, intelligent robotics, “Sassuru” interfaces, acquisition of concept and meaning of words by robot.
source, or the location of the person speaking to the robot. A camera is then directed toward the source to capture an image, which is processed for human face and body detection based on brightness and color information. Based on this information, the robot can determine whether or not a person is indeed present; identify the person if present; and select the appropriate set of interactions for the person identified.

The second part consists of technologies involving the autonomous motion of robots, including automatic map generation of surroundings and simultaneously self-positioning. The unique feature of our technology lies in the precise map generation results achieved through statistical descriptions that seek to identify whether objects are fixed or mobile—in other words, whether an object should be included as permanent fixtures in the generated map—based on assessments of the potential for movement in objects, such as doors (open/shut) and moving objects, like people in the surroundings.

Autonomous Mobility of Robots in Ordinary Environments

A major characteristic of our robot is autonomous behavior. It draws on information gathered from its surroundings, including information on distance, color images, and sound, to make independent decisions. We began by establishing a decision-making process to allow robots to pass by each other in a narrow corridor, as humans do, and allow robots to adjust their relative position to those whom they happen to be accompanying (parallel/cascade formation), depending on oncoming persons or obstacles. We devised a unique method to develop these capabilities: It is assumed that when a robot travels together with a person, the robot demonstrates a strong attractive force that keeps it to the right or left of the person and a strong repulsive force from oncoming persons. A potential field is calculated for the changes in attractive/repulsive forces experienced by the robot for each incremental moment as it approaches an oncoming person. By programming the robot to move towards the point having the lowest potential, the robot can be made to move to the front or behind its accompanied person while avoiding collisions with oncoming persons.

Advantages

Development of Computerized Facial Caricature Technologies Based on Objective Descriptions of Facial Features

Our technologies for the computerized facial caricature artist are special in that they numerically convert all facial data to generate an objective description. This unique tool for facial feature analysis and synthesis can treat all information associated with a face, such as shapes and configuration of the facial features, facial expressions, and even facial impressions, in an objective and comprehensive manner as a combination of quantified data—weighted values of principal components.

Since the various facial features are described numerically and presented in visual manner as a facial caricature, the system permits an efficient retrieval of the facial database when making searches based on features that match those of a given facial caricature, or even based on facial impressions described with words: for example, eyes tilting up; firmly set mouth; or stern visage.

"Sassuru" and Social Skills: Making Robots Behave More Like Humans

Not only will our robots recognize humans in their path as obstacles and move to avoid collisions, they will read our state of mind ("Sassuru") while doing so by determining what actions the humans they are avoiding expect. The behavior and actions of robots will also depend on the social relationships between them and each person. This will mark a significant step forward in creating robots that behave more like humans.

Our study is currently focusing on the task of a robot accompanying a person in addition to a robot moving about by itself in a crowd. We are studying situations in which a robot accompanies a single person, as well as others in which a robot leads a group of people, a robot joins a person walking apart at some distance. We are also studying functions that will allow the robot to take into account the social attributes of its accompanied person and act accordingly: for example, closely attending elderly persons or children or keeping an appropriate distance in formal situations.

Future Prospects

Developing a Robot by Integrating Two Component Technologies into One

We hope to confer on our computerized facial caricature artist robustness that will make it capable of handling data obtained under various environments for photography, as well as generating facial caricatures that offer near professional levels of expression. Facial images will also play a vital role in communication. It is our hope that the system will find a wide range of applications.

While our current studies of robots, facial recognition, and computerized facial caricature systems are independent efforts, we plan to integrate these technologies to create robots capable of making accurate assessments of three-dimensional surroundings and the activities of multiple people—robots capable of making independent decisions and interacting with us in our daily lives in various different ways.