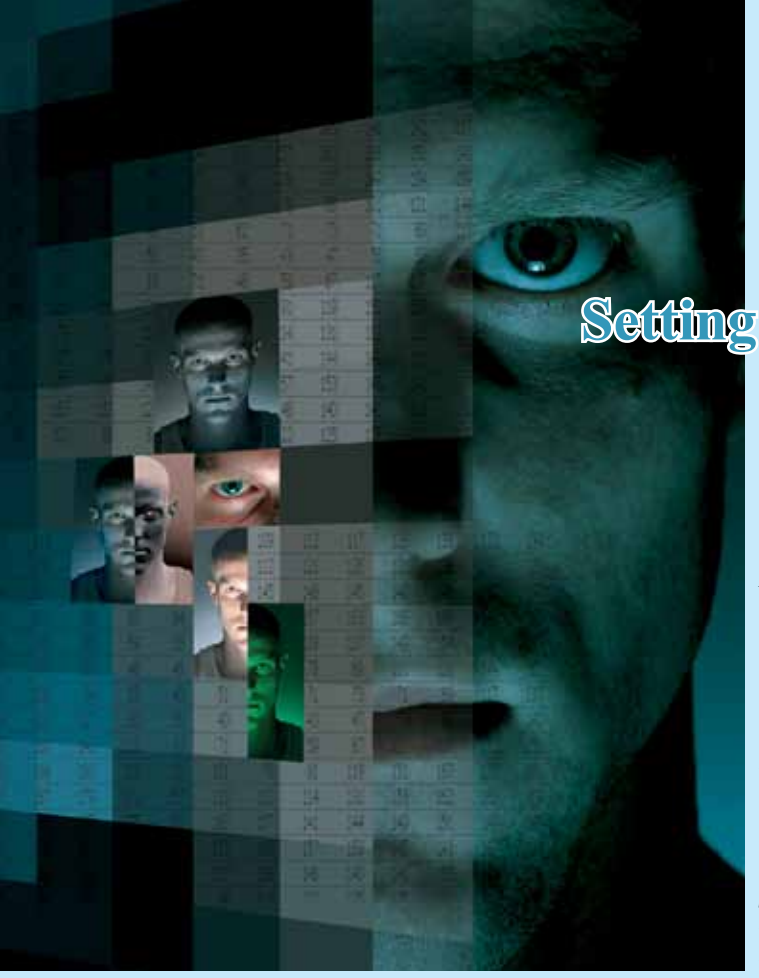

Setting the Computer's Sights

One challenge computer vision has to address is being able to match the capabilities of the human eye. Dr. Tal Hassner of the Department of Computer Sciences at the Open University and his team have created a program which enables computer recognition of faces with limited indicators, successfully competing with the leaders in the world.

Dr. Tal Hassner, along with his colleagues from Tel Aviv University, Dr. Lior Wolf and his student Yaniv Taigman (also from the Israeli start-up face.com) decided to tackle one of the most difficult problems computer vision has to address: *Are these pictures, with varied backgrounds and from different perspectives, representative of the same person*?

Using the internationally recognized benchmarking figures of the University of Massachusetts, Tal and his colleagues have scored 86% reliability, 12 points better than the original, state-of-the-art program from 2008.

To understand why this question poses so many difficulties, and Tal's team's results are so impressive requires a deeper understanding of how visuals in general and faces in particular are interpreted by the computer and by humans.

How Humans Interpret Faces

Imagine this. You hand your passport over at a border crossing. You have dyed your hair and changed your haircut since you took your passport picture nine years ago. Are you the same person as depicted by the passport picture?

You are a criminal who is fleeing a crime site. You hide your face, but the camera picks up some facial features. Can law enforcement officials identify you?

An individual will have little to no problem recognizing facial features – the set of your eyebrows, the shape of your nose, the contour of your lips.

"Our visual systems are very adept at detecting and recognizing faces around us, even at a young age. As humans, we are able to lock onto features which may be statistically very small, yet we perceive them as very strong keys for recognition." Tal says.

How Computers Interpret Faces

Computer vision aims to extract information from digital images and videos about the 3D scene depicted in them. Tal Hassner explains, "we basically want to teach the computer to do everything we do with the visual system."

Can the computer be taught to see images as the human eye does? The complexity and challenge of this conundrum has intrigued the scientific community for years. Indeed, the very notion of perspective has intrigued peoples for nearly two millennia -- the Greeks, Romans, Renaissance artists like Leonardo da Vinci, and many others.

Computers attack this problem by assigning two sets of numerical values to the picture that they see. Each time the visual changes – the background illumination, the profile – these numbers change.

Up until about six years ago, algorithms designed for recognizing faces and images had enjoyed quite good results. But, these results were largely based on controlled images (i.e. whether the person being photographed is cooperating and the imaging conditions are either known or at least fixed, such as is typically the case in biometric systems.) The question then arose how to extend this performance so as to enjoy solid results even in cases where the individual is not collaborating and conditions may vary freely. Merely by raising the question, the issue was complicated significantly.

From Artificial Intelligence to Security

The evolution of the multidisciplinary science of computer vision can be traced back to AI (Artificial Intelligence), when scientists were interested in extracting information from images. Computer vision is an extremely interdisciplinary field with close relations to many other fields in computer science and indeed science in general.

According to Tal, "computer vision is one of the biggest fields of research in computer sciences both for academic and commercial reasons. Indeed, the amounts of money that are being invested in this field are staggering and whichever came first – whether the interest or the moneys invested in research – the field has experienced unbelievable growth."

In actuality, we have all encountered computer vision applications in our daily lives, although we may not categorize them as such – MRI's, X-ray tomography, computer games, facebook, and digital cameras.

The military is a major user of computer vision (missile guidance, detection of enemy soldiers, transportation of men and materiel, etc.), and with the many and diverse security needs computer vision researchers have been catapulted to the forefront of the scientific field.

Matching Image Pairs

Dr. Tal Hassner and his colleagues from Tel Aviv University jumped into the crowded fray to address the following problem: are these two images, both of whom the computer has not seen before, the same or not?

Think about the border crossing scenario. Or the thief absconding with the goods.

And before continuing, consider this interesting anecdote to give you a sense of the difficulty in answering this question. About two years ago, a large scale government-funded computer vision trial research project was conducted in England. Researchers wrote an algorithm to help determine whether the person standing at the border is really the person in the passport photo. The standard sensitivity sent about 70% of the people for verification by human. And, by slightly lowering the sensitivity level, the computer ended up identifying Wynona Rider and Osama Ben Laden as the same person.

Tal and his colleagues designed a new set of algorithms that were providing some outstanding results when measured against the international benchmarking system developed by the University of Massachusetts. Commonly known as the Labeled Faces in the Wild (LFW) image sets, researchers are given ten sets of image pairs, with each set containing 600 image pairs, 300 are the same and 300 are not. You perform the test ten separate times and calculate the standard deviation.

The state of the art result in 2008 was 74%. Then Tal's team came along. "We couldn't beat that benchmark in the beginning," Tal reports. "When we first published we had reached 78%, but were soon beaten."

Touché

Unwilling to throw in the towel, they came back. "We developed new techniques which improved performance even more – our most recent results were better than 86%. Right now, we are considered state-of-the-art."

A small Israeli start-up, face.com is basing their successful facebook application on the fruits of the research made by Tal's team.

These most recent results are approaching the capabilities of face recognition by humans. "Humans can't make it to 100%" Tal elaborates, "we fall somewhat short of that, but the gap between human vision and computer vision is being narrowed."

Currently, they are working on another test where more information is available and results are so far approaching 90%.

Achieving that goal will make computer systems far more efficient and reliable in recognizing people's faces in general images -- better than currently, and hopefully better than humans.

Open Research Day at the Open University

Other research projects presented at Research Day included:

Studies in Contemporary Israeli Cinema. How have trauma and post-trauma shaped the Israeli collective memory? A joint study with Prof. Nurith Gertz, Dr. Sandra Meiri and Dr. Yael Munk of the Department of Literature, Language and the Arts is exploring this subject.

Jewish Women, Family Law and its Practice: Yemen and Palestine. Dr. Bat-Zion Eraqi Klorman, of the Department of History, Philosophy and Judaic Studies, is conducting a new research project on how immigration to Israel impacted on the Yemenite Jewish population.

The Palestinian Citrus Industry, 1850-1948. According to Dr. Mustafa Kabha of the Open University and Dr. Nahum Karlisky of Ben Gurion University, there was extensive collaboration between Jews and Arabs in the citrus industry during pre-State days.

Software Engineering Research Lab. Prof. David H. Lorez of the Department of Mathematics and Computer Science is working with students with hands-on experience from the high tech industry. Together, they are conducting long-term basic research to learn more about open-source software projects.

Rare-Allele Detection Using Compressed Se(que)nsing. Dr. Noam Shental of the Department of Mathematics and Computer Science is working in collaboration with Dr. Amnon Amir of the Weizmann Institute of Science, and Dr. Or Zuk of the Broad Institute of MIT and Harvard in applying pooling designs to detect carriers of rare alleles (gene sequences) in groups of individuals.

Reading and Visual Processing Strategies. Where do the left and right hemispheres enter in terms of the perceptual analysis of words? Dr. Gal Ben-Yehudah of the Department of Education and Psychology is examining this issue in depth.

The Soccer Paradox: Luck vs. playing well. Which is it on the soccer field? This is a joint research project between Dr. Yuval Eylon and Prof. Amir Horowitz from the Department of History, Philosophy and Judaic Studies.

Aseneth the Gentile Church: Reading Joseph and Aseneth in a Christian Context. Was the author Jewish or Christian? According to Dr. Rivka Nir, of the Department of History, Philosophy and Judaic Studies, "the work was composed by a Christian for Christian purposes."

Vision at a Glance: The Effects of Context on Object Recognition. Dr. Nurit Gronau of the Department of Education and Psychology is researching whether contextual relations between objects streamline perception and recognition.

Implicit "Absolute Pitch" and Exposure to Musical Keys: Effect of Familiarity on the Perception and Evaluation of Music. Dr. Eran Chajut of the Department of Education and Psychology of the Open University of Israel and Moshe-Shai Ben Haim and Prof. Zohar Eitan of Tel Aviv University's Buchmann-Mehta School of Music try to answer the question: Does a sizable portion of the population enjoy "absolute pitch" identification?

The Effect of Unconscious Motivations on Psychological Distance. Are things closer or further from us? That may depend alot on your psychological perception, according to Dr. Ravit Nussinson of the Department of Education and Psychology.

Studies in Behavioral Neurobiology and in Urban Ecology. Studies, headed by Prof. Anat Barnea, Head of the Research Authority and faculty member in the Department of Natural Sciences, are examining brain plasticity and adaptive behaviors of birds.

Control of Cellular Growth and Proliferation by the TOR Gene. Dr. Ronit Weisman of the Department of Natural Sciences is using yeast models to identity novel potential anti-cancer drugs.

Study of Quartz Grain Rubefaction in Sand Dune, Red Sandy Soils and Sandstone. Dr. Nurit Taitel-Goldman of the Department of Natural Sciences and Dr. Vladimir Ezersky of Ben-Gurion University are researching red sandy soils using high resolution transmission electron microscopy.

Research

The Study of Sprites Above Thunderstorms. Prof. Yoav Yair of the Department of Natural Sciences, and Dean of Development and Learning Technologies is researching sprites in the Earth's atmosphere and on other planets.

Novel Immunotherapies for the Treatment of Myasthenia Gravis. Prof. Miriam Souroujon of the Department of Natural Sciences is conducting Treg-based clinical trails in MG patients based on her research.

Canaanite EBIB "Proto-Metallic Ware." In a joint research project, Prof. Shlomo Shoval of the University's Department of Natural Sciences, Dr. Yitzhak Paz of Tel Aviv University and Olga Zlatkin of the Open University disprove some time-held theories about man's capability to produce ceramics and pottery during the Bronze Age.

Monitoring Fetal Growth Based on Individual Growth Curves. A tailor-made prediction tool for normal pregnancy, according to Dr. Diamanta Benson-Karhi of the Department of Management and Economics, can more accurately predict fetus growth.

Computational Game Theory. Dr. Rica Gonen of the Department of Management and Economics is developing a multi-disciplinary approach to designing computer-assisted human-drive applications.

Control and Resistance in the Built Space. An in-depth look at the ways in which the Open University campus serves (or does not) the organization's goals and people is part of a research study being conducted by Dr. Varda Wasserman of the Department of Management and Economics in cooperation with Dr. Diana Dolev of the Holon Institute of Technology.

Discrete Event Simulation as a Research Tool in Industrial Engineering. A research project, by Dr. Yuval Cohen of the Department of Management and Economics, is aiming to design better simulation tools for better decision-making.

The Baby Boom and World II. Dr. Yishay Maoz of the Department of Management and Economics in collaboration with Dr. Moshe Hazan of The Hebrew University and Prof. Matthias Doepke of Northwestern University are exploring a new hypothesis: the baby boom of the 1950's sprang from enhanced employment of women during WWII (rather than the time-held notion that the baby boom was a result of them returning home.)

The Tradeoff between Force and Casualties: Israel's Wars in Gaza, 1987-2009. Prof. Yagil Levy of the Department of Sociology, Political Science and Communication is seeking to create a new model called Force Casualty Tradeoff (FCT) to examine the decision-making process of Israel's military in recommending increasing or reducing the use of force.

Pop-Rock Music and Aesthetic Cosmopolitanism. The impact of Pop-Rock music and cultural globalization is being studied by Prof. Motti Regev of the Department of Sociology, Political Science and Communication.