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No dumb machine

Machine Intelligence and the promise it holds.

Ambar Singh Roy

Making sense of the pattern.

The human brain is a very sophisticated machine. The human mind has a natural process of thinking, and has the capability to imagine as well. The basic aim of machine intelligence is to understand the mechanism of human thinking and make a machine think as intelligently and equip it to react faster and more efficiently than human beings.

For example, thousands of blood samples have to be tested urgently to detect a virus. Manual testing will take days before any action can be initiated. In such cases, machine intelligence can help speed up identification of the virus among the blood samples. Again, with regard to detailed census reports, character recognition on the basis of machine intelligence can facilitate speedy collation of detailed and specific data, which would have taken weeks to be collected and collated manually.

Just imagine an American businessman in Washington talking over the phone with his Japanese counterpart based in Tokyo. The American speaks in English but the Japanese gets to hear what is said in his own language. How does its happen? The telephone exchange through which the call is routed has voice recognition capabilities and translates English into Japanese and Japanese into English on a real-time basis based on machine intelligence capabilities.

It was Alan Turing, a British mathematician who cracked the Nazi codes during World War II, who laid much of the groundwork for the creation of modern digital computing and machine intelligence. While his dream is yet to be fully realised, a group of scientists and academicians located in different geographies across the globe are working overtime to facilitate the fruition of Turing's dream.

Towards this end, the Indian Statistical Institute (ISI) at Kolkata hosted the Second International Conference on Pattern Recognition and Machine Intelligence in December 2007.

Eighty-two participants from across the globe deliberated and discussed developments pertaining to pattern recognition and machine intelligence and related fields. They talked of encouraging academic and industrial interaction and promoting collaborative research and developmental.

Says Dr Malay Kumar Kundu, Professor in the Machine Intelligence Unit of ISI: “Machine intelligence is a paradigm by which researchers are trying to create a machine which has a human-like decision-making capabilities and can understand human-like correspondence and reacts to an evolving situation just as a human being would.”

Such a paradigm conveys the core concept of pattern recognition and machine learning with advanced technologies like fuzzy logic, artificial neural networks, evolutionary computation, particle swarm optimisation and rough sets, collectively called the soft computing paradigm, he adds.

Dr Kundu says that the soft computing paradigm provides techniques for flexible information processing to deal with real-life ambiguous situations.

The research and investigations currently being done in the Machine Intelligence Unit of ISI comprises developing these technologies individually and in an integrated manner and demonstrating their effectiveness in solving various problems of pattern recognition, machine learning, image and video processing, biometrics, data mining, bio-informatics etc, that are related to the design of intelligent systems. In fact, considerable work on machine intelligence is being done in the fields of web intelligence and data and web mining.

According to Dr Sankar K. Pal, Director of ISI, the applications of machine intelligence are infinite.

From applications in the medical, healthcare and defense sectors to sourcing of remote sensing data, voice recognition, dynamic imaging, weather forecasting, gathering mining intelligence inputs, etc, machine intelligence can find varied applications, says Dr Pal.

Dr Pal feels that a lot of research work remains to be done in the domain of machine intelligence. “There will be progress in the field but human expectations will always march ahead of technological progress. Machine intelligence is based on intelligent algorithms and facilitates faster decision-making. A human brain has its own limitations. And it is here that the machine scores”, says Dr Pal.

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Education Plus

Campus connect

Research trends: Speakers at a conference on advanced computing organised at the Thiagarajar School of Management.

The third national conference on ‘Recent research trends in advanced computing' was organised by the Department of Computer Applications of Thiagarajar School of Management recently.

The conference was conceived and executed in such a way as to bring talents from different fields of advanced computing. Malay Kumar Kundu, Professor, Indian Statistical Institute, Kolkatta, in his inaugural address, emphasised the importance of quality research and highlighted the current research scenario in various fields of advanced computing.

The research papers submitted at the conference covered various domains of advanced computing such as data mining, mobile computing, distributed computing, soft computing, intelligent computing, multimedia systems, image processing, software

engineering, high performance computing, e-commerce and networks and security. Dr. Kundu also delivered a lecture on ‘Soft computing and its application in image processing.' He highlighted the importance of hybrid combination of soft techniques with various applications such as Content Based Image Retrieval, finger print data analysis, remote sensing image analysis and digital watermarking.

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The Student Nurses Association of India and the National Service Scheme of organised a continuing nursing education programme for students and teachers of C. S. I. Jeyaraj Annapackiam College of Nursing and Allied Sciences.

It focused on the importance of primary health care movement and its salient features. Pandian, Health Inspector, stressed the importance of primary-level disease prevention, immunisation and its impact on rural masses. C. Jothi Sophia, Principal, explained the primary health care training programme of nurses at Tirupparankundram Primary Health Centre. Merlin Jeyapal, Vice-Principal, welcomed the gathering. D. Edwin Rajakumar, NSS Programme Officer, explained the various activities on health care being undertaken by community health and social action department of the college. Ajin P Itty proposed a vote of thanks.

The educational committee and the NSS of the college conducted a seminar on ‘Climate changes and its impact on development.'

Ponraj, environmental educational officer of the department of social concerns, Diocese of Madurai-Ramnad, spoke on global warming. Ramkumar HRD Officer, DHAN Foundation, spoke on climate change. Chidambaram, Coordinator, Madurai Green, explained the importance of tree plantation. Prof. Jothi Sophia distributed tree saplings to the participants.

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A 15-day programme on ‘e-teaching and e-examination' was conducted for the newly recruited staff of Tamil Nadu Agricultural University by the Agricultural College and Research Institute. The programme was intended to introduce the participants to the use of multimedia tools and face ground level problems encountered in on-line examinations.

It was inaugurated by K. Vairavan, Dean. A. Daniel Viswasam

Samuel, Head, Department of Agricultural Economics, welcomed the gathering and P. Prema, Assistant Professor (Computer Science), proposed a vote of thanks.

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A lecture on ‘Tips on leadership' was delivered by KR. Gnanasambandan, vice-president, Tamil Nadu Small and Tiny Industries Association at Michael Institute of Management.

R. Bernard Shaw, Director, presided. P. Anbuoli welcomed the gathering and R. Karthick proposed a vote of thanks

S. Selvaraj, Deputy General Manager, TVS and Sons, delivered a lecture on ‘Emerging trends in HR' at the institute. K.S. Karthik Babu, Assistant Professor, welcomed the gathering and J. Joshua King proposed a vote of thanks.

The Telegraph

Monday, April 24, 2006

Your face is on camera

The Election Commission is using face-recognition technology to weed out bogus voters. But is the system foolproof, asks Prasun Chaudhuri

When you go to polling booths to cast your votes this Thursday (April 27), you may feel intimidated by digital cameras that capture snapshots of your face. Using facial-recognition software, officials at the Election Commission (EC) of India are trying to match your face with those of hundreds of thousands of registered voters in their database. The technology is meant to weed out people who are trying to vote twice, says Debasish Sen, chief electoral officer of West Bengal. The use of face-recognition technology for voter identification and authentication was introduced in India when Bihar went to the polls last year. This relatively inexpensive technology has helped the EC eliminate fraudulent voters who show up under several aliases ? and deprive genuine people from casting their votes ? to sway the election in favour of a particular party. The software has also been successfully used in the US, Mexico, Uganda and several other countries to do away with bogus voters.

Non-intrusive

Face recognition is ideally suited for a voting system, provided a proper database of genuine voters exists, says Dr Malay Kumar Kundu, professor in charge, machine intelligence unit of the Indian Statistical Institute in Calcutta. It automates a very complicated process of identification in a split second.

According to Kundu, facial recognition is one of the hottest areas among the larger group of technologies known as biometrics, which uses biological information to verify identities. The basic idea behind biometrics is that our bodies contain unique properties that can be used to distinguish us from others. Besides facial recognition, traditional biometric authentication methods have used fingerprints, palm prints and voice identification.

The advantage of face recognition technology is that it is non-intrusive, which means it can be used clandestinely even if an individual doesn't co-operate, says Kundu. In other words, the technology can even be used to secretly pick up someone's face in the crowd for surveillance. Which is why the technology is also being used to pin down criminal and suspected terrorists in crowded places, he adds.

People have an amazing ability to recognise and remember thousands of faces, says Dr C.A. Murthy, head, machine intelligence unit, at the ISI. Murthy is working on a project on face recognition at the institute. Computers are being used to mimic that innate ability by turning a face into a digital code so that it can be compared to thousands, if not millions, of other faces, he adds.

If you look in the mirror, you will see that your face has certain distinguishable features. The peaks and valleys ? such as the tip of the nose, the depth of the eye sockets and the distance of the jawline are known as control points or nodal points on a human face, says Murthy. While a human face has 80 nodal points, only 14 to 22 are used for recognition. We concentrate on the inner region of the face, which runs from temple to temple and just over the lip, called the face blob or golden triangle, says Kundu. According to him, a good caricaturist has an eye for the nodal points which inspires him or her to amplify, say, Atal Bihari Vajpayee's lips or Tony Blair's ears.

Mapping contours

The heart of the system is a mathematical technique or an algorithm called Local Feature Analysis (LFA) or Principal Component Analysis (PCA) which maps the contours and creates a faceprint or a unique numerical code of a particular face. Once the system has stored a faceprint, it can compare it with the millions of faceprints stored in a database. Under optimal conditions, the software should be able to match a new face with a database in four out of five cases, says Kundu. However, a lot depends on the clarity of both the photos in the database and the images being captured and searched. The match rates could fall if the face is recorded at an odd angle or in dim light.

3D images best

The system is not foolproof, however, says Murthy. Most of these software programs innovated in the US or Europe do not account for faces with long beards or turbans on the head, he says. Incidentally, the software used by the EC was turned out in France. Facial hair or wrinkles on the face could also upset all measurements in the algorithm, he adds. In addition, the software works best when the image is three-dimensional and is captured through a video camera from different angles. If you capture a mug shot through a simple digital camera, what you get is two-dimensional image. If it's a 2D and black and white image you lose a lot of vital information such as the skin tone. However, face-recognition software launched by the US-based company Identrix claims to have eliminated all these problems and has shown nearly 100 per cent accuracy.

It remains to be seen if the cutting-edge technology used by the EC makes the polls free and fair in West Bengal.

Will fuzzy logic glitter in Calcutta Sky ?

Prof. Lofti Zadeh of University of California, Berkeley developed in 1965 a mathematical treatment of imprecise information like "pretty fast", "rather warm", "not very young" etc. which we use every day in our communication. This he named "Fuzzy Logic", a system that allows intermediate values to be formulated mathematically and processed by computer which often needs a Crisp information like "ON", "OFF", "START", "STOP", etc. Following Zadeh's work scientific and technological community carried forward considerable research and development work and have developed many products whose operation is based on "Fuzzy Logic". Examples range from Cement Plant Control, Video Camera, household appliances like "Washing Machines and Vacuum Cleaners" to traffic technology and management decision making. In much the same way that air travel and digital communication have compressed physical distances, fuzzy logic is set to shrink the gap between human thinking and computer programming. Based on graded rather than true/false statements, fuzzy logic gives computers an entirely new and far more precise way of "perceiving" and thus reacting to the real world.

Zadeh's brainchild thus opened the door to a more human like way of thinking in computer programming-a way that allows an expert's knowledge to be linguistically described and incorporated into processes that do not absolutely required mathematical descriptions. Thirty years down the road since Zadeh's proposition European, Japanese, American and Chinese manufacturer's are discovering that fuzzy logic often in combination with neural networks and expert systems can hold the key to sharply improved utilization of energy, raw material, overall quality in industrial and domestic equipment/process and improved diagnosis in medical applications. Neural computing is concerned with in some way emulating the computing aspect of neurons in human brain by suitable computer software or hardware and expert systems generate the human expertise in a computer program for decision making.

Although, fuzzy logic was developed in US by Prof. Zadeh and some European and American manufacturers have used them in real life problem solving, most applications have been seen in Asian countries e.g. Japan and China. Thus some scholars Claim that fuzzy logic has remained essentially an eastern philosophy and phenomenon although originated in America.

To be little proud of, one can cite that in India an authoritative centre for study, research and application of fuzzy logic has been set up in our Eastern metropolis, Calcutta. Started by Prof. D. Duttamajumdar in India statistical Institute in Calcutta the Centre for Electronic Sciences and communication Unit and now also separate group in Machine Intelligence Unit in ISI have been doing very high level theoretical research in the area of fuzzy logic and neural networks. They have also acquired a tremendous capability in image processing application of fuzzy logic and neural network and carried out research in the application of these to medical field. Quite a few scientists in this institute have received World acclaim. Prof Shankar Pal, Prof N R Pal Prof M K Kundu are to name a few among the team which received international recognition. In Japan, more than forty companies have joined and set up a research lab named "Laboratory International Fuzzy Engineering (LIFE)". This group has been the main force for Japan's flourishing application of fuzzy logic in industrial products and systems. In People's Republic of China today 10,000 scientists are working in Fuzzy logic.

As stated earlier, Fuzzy and neural systems have wide application and some of them could be

- **Domestic appliances**
  - Washing Machines, Vacuum Cleaners
- **Industrial Control**
  - Controller Tuning, Neurofuzzy Control of Steel Plant, Cement Plant Control, Chemical plant Control and Optimisation, Boiler Plant Modelling and Predictive Control applications, AC Drive control applications, Arc Furnace Control.
- **Image Processing**
  - Finger print detection, Automatic Signature verification, interpretation of Satellite data from remote sensing applications, Biomedical image processing in X-Ray and diagnosis of tumour and their classification.
- **Signal Processing**
  - Speech Processing applications, Bio-medical Signal processing like analysis of 24 hrs ECG records, EEG for spike detection and use in diagnosis in epilepsy and EMG Signals.
- **Medical Prosthesis**
  - Wheel chair control for Orthopaedically handicapped.
- **Management decision making.**
- **Traffic Technology**

In the Eastern part of India specially in Calcutta today there is nothing sort of a modern expertise in technology which the Calcuttans can boast of. On the contrary coincident with fuzzy logic's identification of being Eastern, there is considerable expertise in this area in Calcutta. This could be meaningfully exploited for industrial usage and in other aspects in real life problem. We can evolve a Cooperative Research & Development environment in and around Calcutta. We have following organizations where we can look for such a support:

- **Indian Statistical Institute**
- **Jadavpur University**
- **University College of Science and Technology**

I. Radio Physics and Electronics Institute
II. Applied Physics Department
III. Chemical Engineering Department

- **BE College**
- **Medical Colleges**

1) Medical College and Hospital
2) NRS Medical College
3) PG Hospital

- ***Indian Institute of Technology, Kharagpur***
- ***Webel***
- ***Allen Bradley India Limited***
- ***Cegelec India Limited***
- ***Bells Control***
- ***Crompton Greaves***
- ***National Metallurgical Laboratory, Jamshedpur***

- ***Tata Iron & Steel Co., Jamshedpur***
- ***R&D Organization for Steel, Ranchi***
- ***Department of Electronics, Government of India***
- ***Department of Science & Technology, Government of India***

We can note the success of Cooperative R&D policy followed by Indian Oil Corporation for a long time and currently being pursued by Centre of High Technology, Ministry of Petroleum.

Although it is not possible to follow the role model of LIFE in Japan, we can evolve a mini scale R&D cum production Scheme in this area. May be centered around ISI a cooperative research development and product development team can work. Webel should come forward to provide the necessary industrial support and infrastructure. Expertise available in various institutes and companies and with some not able experts of Calcutta origin can be exploited with only one objective that we must excel in theory and application of fuzzy logic and neural network. ISI must be given public encouragement for such deep theoretical research in fuzzy logic and pattern recognition and other medical applications. Jadavpur University, BE College and ITI, Kharagpur should come forward for interdisciplinary team work. Industries like Allen Bradley India Ltd., Cegelec, Crompton Greaves should help in offloading their fuzzy product development schemes to such a centre. Likewise steel industries should sponsor projects. West Bengal Govt. must take it very seriously to encourage and formulate setting up such an R&D cum production support set up. Deptt. of Electronics and Deptt. of Science & Technology should sponsor these activities. Expertise available on application specific integrated circuits in IIT, Kharagpur can be used for development of real life fuzzy chips. Interest in Drive technology in Jadavpur University and B.E. College could be redirected towards application of fuzzy logic and neural network application in AC drives being carried forward by Prof. Bimal Bose, USA (of BE College origin). Help of Prof.B.K. Bose could be sought who is intimately connected with Japan's program in drive technology. Chemical Engineering Department of IIT, Kharagpur, Jadavpur University and Calcutta University can dedicate themselves to fuzzy modelling, identification, control and optimisation of chemical plants like fluidised catalytic cracking. On a mini scale lot of unemployed youths could be engaged in proto type development in fuzzy hardware and software products and training of neural networks for various applications. Chains of Calcutta Hospitals should start fuzzy and neural network program in medical diagnosis and processing of biomedical signals like ECG, EEG and EMG Success of ISI in these areas should be the motivating factor to carry out these works. The commitment and dedicated work of ISI scientists will be properly acknowledged and rewarded by scientific and technological community in Calcutta if on a mini scale the collaborative R&D work as described above can flourish.

This small communication is a very small contribution to recognise this possibility. Sincerity, hardwork and dedication can cross the barrier of acute financial shortage and strong determination may lead to realisation of such a dream. If this sketchy proposal receives wide attention and meets with positive feedback a blue print for such a project, the author is sure of, can be drawn up with proper techno commercial feasibility and sustainable development possibilities in the area.

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Will fuzzy logic glitter in Calcutta Sky ?