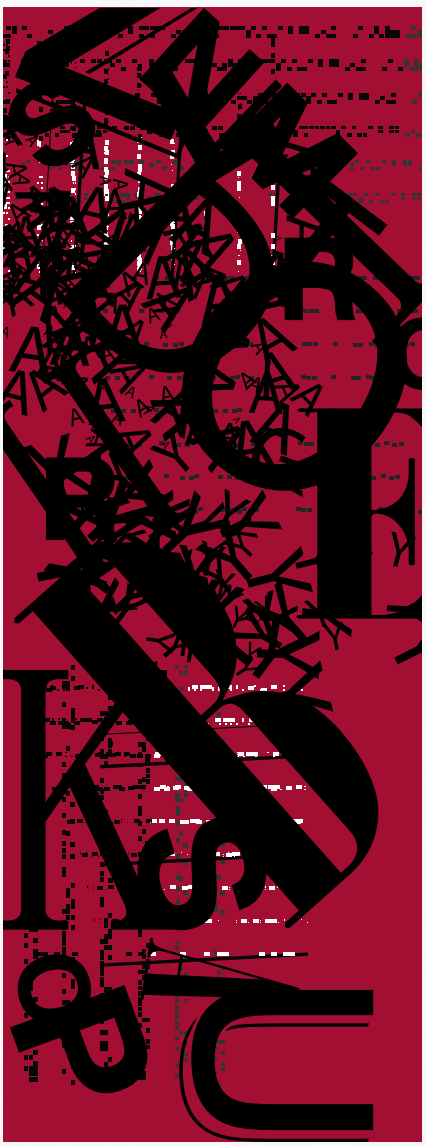
WRITING ON THE



There are two classical pursuits today that aim to reduce the complexities of human ability into machine understanding: voice recognition and handwriting recognition. Voice and handwriting have tantalisingly clear patterns across individuals, and yet the variations are so infinite that it is almost impossible to train machines to recognise every inflection in voice or every curve in handwriting. Not surprisingly, voice and handwriting recognition are the holy grail of computing.

Think about the endless times you have looked at your meeting notes and wondered what it is that the words were. For people who cannot recognise their own handwriting – and 99 per cent of the population, according to industry estimates, falls in that category – simple handwriting recognition tools are the answer.

Or think about the endless times you have looked at reams of handwritten notes, scanning – or 'searching' – for a particular number, date, name, address, place or phrase. We often need to dig out a couple of details from the piles of information recorded within handwritten notes and it can be frustratingly difficult. The answer is to get a machine to turn those notes into digital data and then do a search.

"Handwriting recognition will change the future of technology itself," predicts designer and computer whiz M. Reghuraman of PepperSquare, a Bangalore-based design company that has worked on a project that helps recognise patterns within events. "Today's simple character recognition programs that fail to deliver accurate results will be replaced by sophisticated algorithms that deliver near 100 per cent accuracy," he says.

There is one such company that is ready with a technology that can deliver a fairly high level of as compared to other handwriting recognition technologies available so far. Read-Ink, a Bangalore-based start-up, which has been working on handwriting recognition technology for the last eight years, is ready with a product that will soon go commercial.

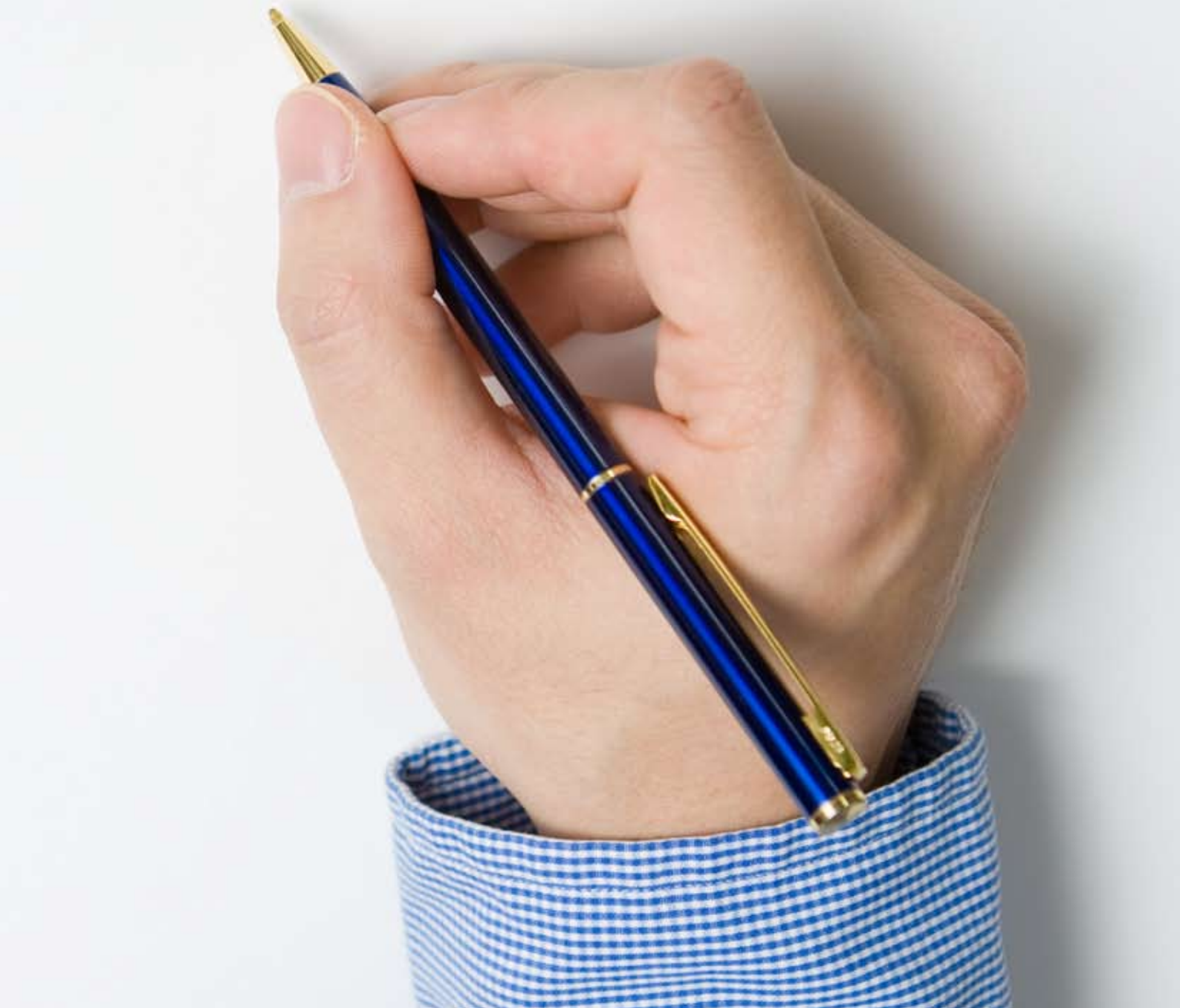
"Globally, the amount of paper that needs `reading' is staggering," says Dr Thomas Binford, the founder, chairman and chief technology officer of Read-Ink. Binford has supervised more than 40 theses at Stanford University, while leading research in computer vision, artificial intelligence, medical image processing, radar image understanding, robotics and industrial inspection.

He has also been a research scientist at the Massachusetts Institute of Technology (MIT) and a Fulbright Scholar at the Tata Institute of Fundamental Research (TIFR), Mumbai. Over the last eight years, with help from some of the best Indian talent, Binford has created a prototype of his solution to the problem of handwriting recognition. Soon, every squiggle you make will become readable, searchable and – best of all – instantly shareable.

The product from Read-Ink will help a multitude of industries. For example, in the health sector, administrators, doctors, nurses and medical technicians

WALL

A new handwriting recognition program, emerging from a Bangalore lab, promises to tap a global US$70 billion opportunity, says **Arun Katiyar.**



> People have different ways of forming characters and no two people are the same. Some use shorthand. Our system is geared to manage all these variants.

fill hundreds of forms each day. These forms are difficult to search through in an emergency. Globally, millions of forms are being filled in, but all of them are stacked in files and have to be manually searched for data. Imagine being able scan all the documents and cull vital trends and patient information from the collective electronic library.

There are other areas where machine reading hand-completed forms would be very useful: take the railways. A clerk at a booking counter handles innumerable handwritten forms and does not even have the time to scan them for errors. Now, with machine reading, it will become possible to scan hand-filled forms for later use.

Similarly, the police can do with first information reports (FIRs) being scanned and stored, insurance companies would like to get all their forms to be machine-read for quick retrieval of data. And, of course, students will be able to store, search and share notes (so far only handwritten) at the click of a button.

In many instances, the margin of error or fault tolerance in the industry uses of machine-reading is very low. And therein lies the success of the Read-Ink research and development. Today, machine-read forms are 95 per cent accurate. But industries such as health and insurance cannot afford to have even a 5 per cent error between the hand- written form and the machine-read version – it could result in loss of life or a legal suit. Read-Ink hopes to improve machine-reading to the point where it is 99 per cent reliable.

The most common understanding of handwriting and character recognition is optical character recognition (ORC) – where a machine scans handwriting or text, examines it, matches it against

A BRIEF HISTORY OF HANDWRITING RECOGNITION

SOME INTERESTING METHODS AND DEVICES THAT HAVE BEEN DEVELOPED FOR HANDWRITING RECOGNITION OVER THE YEARS:

CalliGrapher: The first two commercially available personal digital assistants (PDAs) that used handwriting recognition, Apple MessagePad and Tandy Zoomer, used CalliGrapher. It was a disaster. CalliGrapher used a limited dictionary offering low accuracy and people gave up before the system learnt to recognise their handwriting. High expectations and low performance killed the product.

Apple-Newton Print Recognizer: The upgraded version of CalliGrapher that used only print so that it was easier to recognise the writing. But the method is not intuitive as not everyone uses print all the time.

IBMs ThinkWrite: It used character patterns, strokes and timing to recognise handwriting. It saw limited success.

Graffiti: A Palm Computing product that found success because it completely side-stepped the problem of handwriting recognition. Instead, it forced users to write characters using certain strokes that programmers had thought up. It turned these strokes into text. Brilliant, but people still want to use 'natural' writing (and, of course, learning a somewhat new script for alphabets is always a chore).

CEDAR Penman: An early system that tried to read naturally-written handwriting using an algorithm based on visual clues, extracting data and running it over a neural network trained to figure out words.

OCR: Optical character recognition, the most common form of making text machine readable, storable and searchable.

MyScript: Uses a smart pen and paper to take down notes electronically and records the audio as well. The notes can be stored in a computer and made searchable and sharable using OCR. The physical note can be tapped at any location and the appropriate audio portion will begin to play immediately. Smart, but complicated.

Io: Logitech's pen equipped with an optical sensor to capture notes written on special paper. The Io stores the notes using an image file format. These files are transferred to a PC. The notes can be added to documents or attached to emails. Logitech decided not to have software that converts the notes to searchable text as the accuracy of the available software was not good.

Others: There are several pen and paper based devices priced between US$100 and US$150 that use scanning techniques to store handwriting and read it for further processing. But they are expensive, clumsy and not easily usable in all environments.

'THERE ARE BRIGHT TECHNICAL PEOPLE IN INDIA'

Dr Thomas Binford has been a leading researcher in image analysis and computer vision since 1967. He is often called the 'Father of Computer Vision'. He now operates from the quiet, green and elegant Indira Nagar suburb of Bangalore and is surprisingly familiar with India, often giving the impression of having lived here more than anywhere else..

Binford, founder, chairman and chief technology officer of Read-Ink Technologies Pvt Ltd, has supervised more than 40 theses at Stanford University as professor when he was on the research faculty from 1970 to 2000. From 1966 to 1970, he was a research scientist at the MIT Artificial Intelligence Laboratory working in computer vision and robotics. From 1965 to 1966, he was a Fulbright Scholar at the Tata Institute of Fundamental Research in Mumbai. An interview with Dr Binford:

What brought you to India?

We have been self-funded. We came to extend the time that we could afford to fund development. We knew that we could get qualified engineers to develop our product. Some part of our business will use operations that would benefit from being in India.

Do you plan to continue operating from Bangalore?

Yes, we plan to have a large part of operations and development in Bangalore.

What do you think of India as an incubator of new technologies? Is the environment here right for incubation?

With hands-on development, India has the potential as an incubator of new technologies. There are some bright technical people, costs are lower than in the US, and there is an interest in working in product development and R&D. In making a decision to locate to India, care must be taken to structure the technical team to take advantage of bright but green engineers.

What is the difference between doing your work in India and in the US?

My comparison is between Silicon Valley/Stanford and Bangalore in terms of building highly technical products in artificial intelligence (AI), machine learning and computer vision. In Silicon Valley, there is a large pool of technical people with a strong scientific background and experience in development, but the cost structure is high.

In Bangalore, I am mostly alone. I miss that I cannot just walk across and talk to a Stanford colleague.

Over time we have built a strong team with engineers who are very good and who understand complex algorithms. That has taken time and required an effort on my part, but the team has turned out to be very successful.

patterns stored in its memory and spews it out as electronic text that can be stored, displayed, searched, edited and printed using a computer.

The problem is that ORC has only 95 per cent accuracy – and that is an accuracy rate not acceptable in many industries, discouraging them from using it. "At the moment, our product is able to achieve 98 per cent accuracy," says Ione Binford, the ceo of Read-Ink, "Our target is 99 per cent." The Read-Ink system makes ambiguous guesses about characters and then makes a lexical match; it self corrects, learns with each use and becomes better. "People have different ways of forming characters and no two people are the same," says Ione Binford. "Some people use shorthand that only they understand. Our system is geared to manage all these variants."

According to Thomas Binford: "Only toilet paper is uniform in size and structure. But take the case of invoices – every invoice is different." Indeed, there is a huge market to be addressed – one that will be glad to adopt a system that can bring reliability to scanned, machine-read handwriting.

About US$70 billion is spent globally each year on handwritten forms of the kind used for maintaining records in hospitals, health facilities, insurance companies, universities, police departments, railways, employee records, billing and invoicing, according to industry estimates.

In many cases, statutory legal requirements make it mandatory to store the records for instant retrieval. Crude, manpower-intensive and laborious methods are used to do this at the moment.

Driven by need, various solutions to manage the problem of handwriting recognition have been created. But emerging economies such as India, China and Brazil are expected to adopt a solution that bypasses these and use one that becomes available on a mobile phone – the most ubiquitous device in recent years.

In order to target the mobile phone as a device for quick handwriting recognition, the challenge is in reducing the code used by the software so that even a small computing device like the mobile phone can use it. Read-Ink is currently working on the challenge. Thomas Binford believes that it is not just what he has created that matters. According to experts, the device has been the roadblock to adoption. Can Read-Ink address that challenge? That's the next step.