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Network Access via Wireless Terminals with Chinese Voice: A Breakthrough in Automatic Understanding and Organization of Voice Information

ed by Dr. Lee Lin-shan and supported by the NSC, a research team studying speech processing technology at the National Taiwan University (NTU) Center for Information and Electronics Technologies has spent more than a decade to develop key technologies needed for a Chinese voice online browsing system that can be used at any time or place to retrieve multimedia information. These key technologies enable the use of Chinese voice to perform online browsing and retrieval, and can perform the automatic understanding and organization of voice information. Prof. Lee recently demonstrated these technologies using a comprehensive system to perform these tasks at a conference hosted by NTU President Dr. Chen Wei-jao. The breakthroughs made by Prof. Lee and his team will allow the public to conveniently surf the Internet from anywhere at any time.

According to Prof. Lee, voice network access is currently one of the most important developmental trends. The vast majority of human information activities will be accessed through the Internet in the future, ideally in multimedia form that includes voice information. And this voice information offers a clear description of contents, concepts, and topics, which is optionally suited for browsing and retrieving information. In addition, wireless communications technology has spawned a vast array of light, thin, and compact terminal equipment, gradually replacing bulky keyboard and disk drives. "Voice" seems destined to become the most convenient interface for going online at any time or place. Nowadays all users go online by interacting with network software; in the future, these interactions will be performed by spoken dialog. Other functions such browsing, retrieval, and input can also be performed by voice. Due to the vast amount of information accessible on the Internet, convenience will continue to be of the utmost importance.

Prof. Lee also pointed out that the team's most important breakthrough was completing the development of the automatic understanding and organization of voice information. Taking spoken news on television or radio as an example, Prof. Lee explained how this technology works. The technology automatically segments and classifies spoken news by topic, and then produces a summary and title of each item. This approach will enable users to rapidly retrieve spoken news via voice dialog. For example, users will be able to see titles or listen to summaries before deciding to listen to (or view) the entire news item. This is what is meant by "understand and organize" voice information, and the NTU team currently has the world's most advanced technology to do this.

According to the NTU team's conception, the computer must undergo a process of study before it can automatically assign titles and write summaries. Taking automatic assignment of titles as an example, the research team used 150,000 items of text news provided by the Central News Agency over the past two years plus titles written by reporters and editors as the computer's study material. The computer first established the relationships between the syllables, characters, and words of this material. Afterwards, whenever the computer heard a news item, it first identified the voice information's syllables, characters, and words, and then consulted the established relationships to identify keywords for composing a clear and coherent title.

Understanding and organizing Chinese voice information is extremely difficult. To see why this is so, let's first consider Western alphabetic languages. Because there are few new words in these languages, Western voice recognition technology has always been based on lexicons of all likely vocabulary and relevant sentence patterns. Because of this, special lexicons and sentence patterns must be used for special domains (such as medicine, sports, finance or law). While computer understanding of voice is limited to very narrow domains (such as weather or flight schedules) in Western alphabetic languages, the NTU team has developed a system that can be used in all domains. Moreover, Chinese characters are independent and can be arbitrarily combined to form new words. Online information changes every day, and new Chinese words are constantly appearing. It would be impossible to collect all the new vocabulary in a lexicon. And since there is no way to judge what role a new word will play in sentence patterns, unknown new words cannot be readily identified. On the other hand, new Chinese words are often

keywords essential to understanding the topic, and unless identified, it may be impossible to uncover the topic. Furthermore, voice recognition is inevitably a very error-prone process. The computer must therefore overcome identification errors to achieve correct understanding and organization. Similarly, Chinese new words are often keywords that are used for retrieval. If a new word cannot be identified, the text cannot be retrieved. In spite of these formidable obstacles, Prof. Lee's demonstration showed that the NTU team has successfully overcome these problems.

The demonstration set a milestone in computer recognition of Chinese

and even foreign languages. News was used as an example because it is easy to acquire, contains a vast number of new words, varies widely, and is highly difficult. News is just one type of digital content, however, and the system can readily be applied to other types in the future.

DOTSTAR Aircraft Flies over Typhoon Melor's "Eye"

he NSC program "Dropsonde Observations for Typhoon Surveillance near the TAiwan Region" (DOTSTAR) monitored Typhoon Melor - a rare November typhoon - and deployed observation dropsondes on November 2, 2003. This aircraft surveillance mission employed an Astra SPX jet from the Aerospace Industrial Development Corporation. On this mission, the jet carrying research personnel Prof. Lin Po-hsiung of the Department of Atmospheric Sciences, National Taiwan University, and Prof. Lin Pay-liam of the Department of Atmospheric Sciences, National Central University, took off from Taichung at noon, rounded northern Taiwan, and flew south along the east coast of Taiwan. The aircraft released the first GPS dropsonde near Green Island, passed the southern tip of Taiwan, and dropped several more dropsondes as it continued on a southerly course. Flying at a height of 41,000 feet, the aircraft successfully overflew the center of Typhoon Melor and gathered important data on the structure of the typhoon near its eye. The aircraft immediately turned and flew west upon arriving at the northern tip of Luzon in the Philippines. After rounding the western edge of the typhoon and releasing more dropsondes, the aircraft flew back to the southwestern tip of Taiwan, released its 15th and final dropsonde, and returned to Taichung at 3:00 PM.

According to DOTSTAR principal

investigator Prof. Wu Chun-chieh of the Department of Atmospheric Sciences, NTU, the data collected by this mission indicated that wind speeds in the vicinity of the center of Typhoon Melor were even higher than estimated from satellite data.

Prof. Wu feels quite satisfied concerning progress of observations made under the DOT-STAR program. According to Wu,

past missions all flew around the typhoon periphery in a clockwise direction, and observations of Typhoon Dujuan in September adopted this flight track. By flying over the center of the typhoon, the Typhoon Melor mission yielded the following achievements: (1) By flying over a typhoon centor for the first time, the mission laid the groundwork for future observations of typhoons' central structures. (2) The data collected by the mission can be compared and integrated with satellite data and data from the Chiku and Kenting radar stations, shedding new light on typhoon eyewalls, rainbands, circulation, and structure. (3)



Aerial photo of the center of Typhoon Melor from an altitude of 13 kilometers.

The data will play an important role in improving numerical typhoon track prediction models.

With a flight over a typhoon center successfully completed, the next step for the DOTSTAR program is to perform increasingly comprehensive typhoon observations using an α -pattern flight route. As the DOTSTAR research team continues to harvest important data and gain valuable experience, we believe that future typhoon observations will achieve a high degree of maturity, enabling significant progress in academic research and typhoon forecasting.

Researchers Find that Obesity is the Primary Risk Factor for the Development of Type 2 Diabetes in Taiwanese Children

research project jointly sponsored by the NSC and Department of Health performed large-scale urine screening of children and youths between ages six and 18. This project, which was led by Professors Chuang Lee-ming and Sung Fung-chang of the Department of Internal Medicine, National Taiwan University Hospital, found that the ratio of Type 2 diabetes mellitus (Type 2 DM) to Type 1 diabetes mellitus (Type 1 DM) among school-age children recently diagnosed with diabetes was generally 6:1. Type 2 DM was often accompanied by obesity, a higher rate of hypercholesterolemia and hypertension, and a family history of diabetes. These findings have been published in the journal of the American Medical Association (JAMA, 2003, 290: 1345-1350).

According to Dr. Wei Jung-nan, the main implementer of this research, when children and adolescents are diagnosed with diabetes, it is often initially felt to be Type 1 DM (also known as insulin-dependent diabetes). This is because Type 2 DM (non-insulindependent diabetes) is usually thought to be an adult disease. In spite of this preconception, more and more children and adolescents worldwide are being found to suffer from Type 2 DM.

This research project performed urine screening and stage 2 blood glucose testing of 2,862,083 school-age children and adolescents between the ages of six and 18 throughout Taiwan. Those testing positive in the first screening examination received a second urine test. Those found positive in the second test received a third urine test and blood test. Particular attention was paid to the incidence of Type 2 DM and correlation with risk factors. A total of 15,271 students tested positive for urine glucose in both urine tests. These 15,271 students were given a full medical checkup by physicians, including measurement of body weight and height, blood pressure testing, and sampling of blood. The students were tracked by telephone to establish whether they had Type 1 or Type 2 diabetes.

The project discovered that 581 youngsters suffered from diabetes, and 343 were diagnosed with diabetes for the first time. When tracking was performed on 253 of the 343 new diabetes cases, 54.2% were diagnosed as having Type 2 DM, 8.7% were diagnosed as secondary diabetes from steroid treatment for renal disease and/or systemic lupus erythematosus, and 9.5% were diagnosed as Type 1 DM. The incidence of Type 2 DM was estimated as 6.5 per 100,000, and the total number of newly-diagnosed youngsters with Type 2 DM was six times the number with Type 1 DM. This large-scale screening project verified that Type 2 DM is indeed a major disease of children in Taiwan, and poor diet and obesity are very closely correlated with the rise in the incidence of Type 2 DM (which was formerly considered to be an adult disorder). In addition, analysis of data for 1996 to 2000 from the National Health Research Insurance Database shows that there are currently 900,000 persons in Taiwan receiving outpatient treatment for diabetes. And since diabetes can have no symptoms for as long as eight years, it is conservatively estimated that there are over one million persons in Taiwan with diabetes at present.

According to Dr. Wei, to determine

diabetes risk factors, the researchers compared 1,000 randomly-selected youngsters without diabetes with 137 youngsters who suffered from Type 2 DM. The results indicated that there had been a sudden rise in the incidence of diabetes among 10~12 year old girls and 13~15 year old boys, suggesting a connection with the onset of puberty. It was also found that girls tend to have a higher incidence of Type 2 DM than boys. An identical situation has been observed in other Asian populations. The researchers similarly discovered that 54% of boys suffering from Type 2 DM and 44.4% of girls were obese. It was inferred that the diabetes risk of children with body mass index (BMI) \ge 95th percentile (obesity) was 18.8 times (95% CI 9.22-38.5) higher than that of children in the 50th percentile. Obesity is thus considered to be the main risk factor for Type 2 DM. Other risk factors include a family history of diabetes, high cholesterol, and hypertension. Many of the children are also in a high-risk group for cardiovascular disease. Health authorities should adopt emergency public health measures to curb the steady rise in the number of Type 2 DM patients.

Yet another discovery of the research team was that a low body weight (less than 2,500 g) or high body weight (above 4,000 g) at birth is a risk factor for Type 2 DM in children. This finding suggests that body weight at birth has a U-shaped correlation with risk of Type 2 DM diabetes. This Ushaped correlation between birth weight and risk of Type 2 DM had only previously been discovered in the Pima Indians of the US. The findings of the diabetes screening project have been published in the 2003 *Diabetes Care*.

Development of Total Knee Prosthesis

ost total knee prosthetic components must currently be imported from overseas. Preliminary research indicates, however, that the bone cutting surface of the tibia is nearly circular in Chinese people. The imported prosthetic components have a nearly oblate cutting surface. Furthermore, it has been discovered that Asians have a relatively thin patella. This means that imported knee prosthetic components are not very well suited for most Taiwanese patients. In light of these facts, an industry-university cooperative project supported by the NSC has been developing knee prostheses suitable for Asian. This project - "Project of Research and Development of Total Knee Prosthesis" - which has been carried out by National Yang Ming University, the Department of Orthopaedics at Mackay Memorial Hospital, the Department of Orthopaedics at Buddhist Tzu Chi General Hospital in Hualien, and the United Orthopaedics Co., has successfully developed a knee prosthesis that is expected to be ready for mass production and sale by July 2004. According to Prof. Cheng Cheng-kung, Chairman of the Institute of Rehabilitation Science and Technology at National Yang Ming University, the project research team began studying total knee prostheses suitable for Asians as early as ten years ago, and successfully developed a first-generation knee prosthesis design five years ago. The team's recently announced the new generation of knee prosthesis is a mobile bearing design in which the relative

motion between the polyethylene insert and the tibial baseplate. This relative motion contributes in reducing the constraint between the interface of tibial component and tibia, while also providing large conformity of the knee joint to reduce the risk of polyethylene wear. The geometry and dimensions of this new prosthesis design were determined according to the bone cutting surface of knee joint of Asian. The results of completed biomechanical evaluation showed that the mobile bearing insert design prevents the stress concentration of knee joint when surgical malalignment of knee prosthesis occurs, and also provides excellent joint stability.

An improved "U-Knee posterior stabilizer mechanism" developed in the project was used in the knee joint design. Besides facilitating surgery, this mechanism can also increase the knee stability and range of motion after surgery. And to meet the needs of physicians who are still committed to a non-mobile bearing insert design joint, the project developed a design of this type. Three different types of knee prostheses had developed in the NSC project in order to provide various choices to satisfy with each surgeon's leaning. These types are posterior-stabilized mobile bearing knee design, a posterior-stabilized fixed bearing knee design, and a mobile bearing insert design with posterior cruciate ligament preserving design, respectively. It is believed that these three kinds of total knee prostheses will quickly export to the Asian market,



benefit countless patients, and raise Taiwan's standing as a center of biotechnology industry.

Having completed R&D work, the research team has applied for the patent of the new locking mechanism design of mobile bearing knee and also applied for the certification and approval from the Department of Health in Taiwan. Base on the developing procedure of these knee prostheses, the project has also generated much meaningful data and many new techniques that will be useful in subsequent R&D. The above related information or technology will transfer to the cooperative corporation. The outputs of the project further included 12 scientific papers which were published in or accepted by international journals. Some of above papers have been published in the top three journals in the SCI category of orthopedics research. This honor has further enhanced the reputation in academic position of Taiwan.

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