

Department of Computer Engineering & Information Technology

ABSTRACTS OF PROJECTS FROM B. TECH. (Information Technology)

Bulk Video Uploader

New technologies are being emerged nowadays. Some of them are Big Data, Artificial Intelligence, SMAC, etc. The biggest and the most important among them is Cloud Computing. Amazon Web Services(AWS) is the biggest cloud service provider. Our project uses AWS services to upload bulk videos to Youtube. Traditional uploading is done through YouTube's web interface. It is very time consuming and slow speed process. There is no storage provided over the internet. For people in search of software that can upload bulk videos on youtube, this application is of great use. This application is developed in order to upload a large number of videos in bulk. This is achieved by getting a storage on Amazon S3 and uploading the bulk videos from there on youtube. The storing of video onto S3 helps to save so much time in video upload. The speed of video upload needs to be checked. Even if it is not so fast, it helps us to upload the files on the PC quickly and leave the work. The idea behind this application can go through various steps. Firstly, we need to create an AWS account and login to EC2 instance. The videos are transferred to Amazon S3 and are uploaded to youtube from there. This is how it works.

Optimization of DSR Routing Protocol in MANET using Passive Clustering

In today's world wireless networks are changing day by day. With many wired networks being replaced by wireless networks, the demand for quick wireless infrastructure setup is at peak. Mobile Ad hoc networks(MANETs) are such wireless networks which can be deployed very efficiently without any infrastructure. Generally MANETs are used in situations like floods or other natural disasters where it is difficult to establish or access any communication medium. MANETs are infrastructure-less wireless networks which are formed using different nodes with each node having the capability of receiving, forwarding and routing data packets. These are self-configurable, self-healing, peer-to-peer networks. These networks don't have any central controller which can manage the routing process. The absence of central controller creates many issues in MANETs. When two nodes in MANET want to communicate, they can not use normal wireless routing protocols. Routing protocols need to be redesigned so that they can be used in MANETs. These mobile nodes are powered by using batteries hence efficient utilization of energy is also a concern. Many routing protocols like AODV, DSR etc are designed specifically for MANETs but

these protocols are not very efficient in terms of packet forwarding and energy utilization. Packet forwarding can be done efficiently by dividing the network into smaller clusters. The process of dividing the network into clusters can be done in two ways viz. Active clustering and Passive Clustering. Active clustering uses explicit data packets for creating and maintaining the clusters. This incurs a lot of overhead in terms of bandwidth utilization. Passive clustering on the other hand piggybacks the control information in the outgoing data packets without creating any extra overhead on bandwidth utilization. This project aims at optimization of DSR routing protocol using passive clustering. The simulation results show that optimized DSR algorithm enhances the packet delivery ratio by minimum of 20 % and reduces the RREQ flooding by a minimum of 30 %.

POLLUTION ATTACK DETECTION AND PREVENTION IN PEER-TO-PEER NETWORKS

Nowadays, it is very easy to download a multimedia file on the Internet. Many a times we observe that downloading such files takes a lot of time. This is mainly because of number of clients which are trying to download such files are very large, and available infrastructure is not capable to serve all the clients at the same time. It is very costly to increase internet infrastructure. It is wise to use existing infrastructure and optimize its performance. Nowadays, Peer-to-Peer technology has become very popular. Peer-to-Peer streaming deliver multimedia content over the internet with low bandwidth requirement, high video quality and flexibility. That is why it takes very less time to download multimedia file on Peer-to-Peer network. However, Peer-to-Peer streaming networks are vulnerable to different kinds of attacks. Most common are pollution attacks and those attacks are possible due to distributed and dynamically changing infrastructure. These attacks make Peer-to-Peer network malfunctioning and leads to performance degradation. In this project, the problem of pollution attacks on the Peer-to-Peer networks is addressed. Our contribution in this project is the development of a new algorithm, which efficiently detects pollution attacks and prevents Peer-to-Peer network. Selecting good peers for communication is the most important part of the proposed system. The project aims at making Peer-to-Peer communication more secure and optimizing its performance to make it more usable. The implementation and testing of the system shows that, good peers are selected efficiently and malicious peers are removed effectively from the Peer-to-Peer network. This makes file sharing more secure.

REAL SMART PHONE SYSTEM

Over last decade advancement in technology has fuelled major innovation and development in

mobile phone system. In today's life mobile phones are playing an important role in day to day activities. So many applications are developed in different mobile operating systems to help people to do their activities with ease, to reduce their efforts and to entertain people. These applications are very useful for people. But next innovation in mobile phone expects that phones should behave according to the user's behaviour and that is called as real smart phone system. For example, most common activities are user charging mobile when he is in office or changing mobile profile to silent when in a meeting etc. Likewise observing other patterns, collecting information from it and building intelligence to help him with his day to day activities and making a phone really smart is the aim of our project. Developing a Web Application for Integration

of Social Media Platforms and Proposing a Security Requirements Framework for the

same Man is a social animal. The advent of social networking sites like Face-book and Instagram have helped to further that belief. Social media seems to have taken the world by storm and not without cause. Social networking sites like Facebook and Google+ allow you keep in touch with your friends and family. Instagram lets you share what you see with your friends halfway across the globe. The applications and uses are almost limitless. But with so many different sites available, sometimes it becomes difficult to keep track of all your feeds. You would have to keep multiple tabs open and even then comparing posts for all the social media sites is an issue. While we were performing our research, we found that web application security is an extremely important issue. Most people share all sorts of personal information on social networking sites which are stored by web based applications. Most of these applications are not very secure and as we delved deeper to find the core of the issues, we realized that most of the fallacies could be fixed using good programming practices. Hence we decided to create an application that will provide the user with a single feed that would combine the feeds from various different social networking sites. For our application, we decided to focus on Facebook, Instagram and Google+. Our application will provide the users various options such as

browsing individual feeds, the combined feed, and also give statistics to the user based on their usage of the social networking sites. We also researched about the different security requirements and programming practices that need to be implemented in order to keep web applications like this one, safe from any outside threat.

Today - Contextual Applications

App usage has exploded in the past few years due to the rapid boom in mobile technology and the amount of power that is packed into the smart phones today. The growth of mobile devices is

revolutionizing the way we live by changing the way we carry out everyday tasks like ordering food or buying our clothes. The stage we are at right now is however just a starting point that is going to lead to something much bigger and life changing. The reason mobile technology is so interesting is because it is always present with us wherever we go and is equipped with numerous sensors. The future of mobile technology thus depends on making effective use of these sensors. Contextual Apps are a new breed of apps coming to smart phones and wearable which are destined to change the landscape of mobile computing and apps. These apps are capable of determining where we are and what we are doing and it makes use of this data in order to present us with any additional information relating to our present context in an attempt to automate these tasks. For example, for a user looking to purchase some furniture, the app will tell the user the best place to find them based on his current location, time of the day and other factors that come into play. The main aim of these contextual applications is to ensure usefulness over time. There are a number of applications already in the market which are moving towards this goal, but are not yet making use of the full capabilities of the mobile technology. We propose the development of one such contextual application which will take into account the user's current context (identity, time, location, current activity and social factors). This app will have the ability to sense the subjective and objective aspects a given situation, and thus will improve our ability to perceive and respond in the moment based on our identity, where we are, what we are doing, who we are doing it with, and also our past history of experiences.

ASK - A – FRIEND

Owing to the vast scale of globalization in today's world, consumers everywhere can choose from a plethora of services and products. Making this choice may become an overwhelming task sometimes. Social media tries to simplify this with the advent of various applications such as Zomato, just dial, etc. Reviews on such platforms come from total strangers, which may not always be entirely reliable. However, for more crucial services - such as an orthopedist, or a tuition class, people would prefer advice from their own friends, which would be more trustworthy. Presently, there is no such application that provides consolidated information on various services provided from the users friends themselves. This project aims at providing a scalable and reliable web application that will integrate the information given by the users social circle thus enabling the user to make informed choices about various services. The web application will intelligently analyze and display the data retrieved from the users. The application makes the users login through their Facebook accounts so as to retrieve their friend list. The users are then provided with a variety of services (bookstores, tuition classes, General Physician, gyms etc.) to choose from. The database of

each of these services are populated by the users i.e. the users add their respective providers for each of these services themselves. Facebook friends of the user, using the app, also do the same. On querying for a particular service, the users can make an informative decision judging by the service providers of their friends displayed by the app.

Performance Analysis of AES-DES-RSA

Hybrid Algorithm for Data Security

Network security starts with authentication using a username and a password. As this requires only one authenticating the user name and the password which is also known as 1-factor authentication. Communication between two terminals is encrypted to maintain the privacy. In this project we propose the idea of using a combination of AES-DES-RSA and incorporating it in the Feistel structure. Being a hybrid of three powerful encryption techniques, the algorithm would be an efficient and reliable encryption standard. This project will contain the implementation and design of a hybrid based AES-DES-RSA algorithm for the security purpose. Data Encryption: Using Hybrid AES-DES algorithm Key Exchange Mechanism: Using RSA-1024.

Our Algorithm will mainly focus on following parameters:

1. Avalanche Effect
2. Encryption Time
3. CPU Usage
4. Throughput

iSCSI TARGET COMPLIANCE TEST TOOL

SCSI (Small Computer System Interconnect) is a protocol which is used by servers to communicate with storage devices. iSCSI (Internet Small Computer System Interconnect) is the extension of SCSI working at the top of TCP/IP. By sending SCSI over transport layer, it is possible to access storage remotely. iSCSI is required to make sharing of storage possible and to allow better utilization of storage devices through sharing. The project aims at developing a server based framework to issue specific iSCSI commands to the iSCSI target to ensure that the iSCSI target is capable of handling these commands as per iSCSI protocol requirements. This framework requires developing an infrastructure to send iSCSI commands and assess responses from an iSCSI target to determine whether the response is as expected. For example, an attacker can try to crash the target by sending multiple requests i.e. by attempting Denial of Service attack. The framework provides interfaces to simulate many such types of attacks to test the target in all possible cases. The framework would be

extended to include a UI capability that will allow users to extend the set of compliance requirements as needed in the future.

CREATE BUSINESS INTELLIGENCE SYSTEM AROUND SF VxEXPLORER LOGS

Software failure has become common in the emerging IT sector on a daily basis. Therefore to recover from these catastrophic failures, the support team needs to gather the related data of the clients system and then work on it. An efficient tool can greatly help the team to analyse and then fix these failures on a short notice. Business intelligence is such a tool which can help organizations refine and manage business information with the aim of solving problems and making effective business decisions. Our project basically concerns with the creation of an analysis platform on basis of the logs being generated by the customer machine using SFVxExplorer. We intend to generate analysis reports around the log files in order to present statistics for each user node. Support system team needs such reports for troubleshooting purposes. Once they get the required data about the customers system node, they can create a virtual environment of the same specifications to perform various tests to solve the problem. The overall summary report can also help the support team to figure out the most common problems with the client machines.

Automated Macular Edema Detection

The approximate number of people having Diabetes throughout the world is around 3.47 crores as estimated by the World Health Organization. Macular Edema is a disease of the eye associated with long-standing diabetes. If Macular Edema is detected in time, vision loss can be avoided, however, this can be a challenging task as the disease often shows only few symptoms until it is too late to give effective treatment. At present, detecting Macular Edema requires a trained expert to examine and evaluate digital photographs of the retina and hence, is a time-consuming and manual process. The human experts submit their reviews usually a day or two later, causing the delayed results to lose follow up, miscommunicate, and delay in treatment. Experts can detect Macular Edema by the presence of exudates associated with the abnormalities in the vessels caused by the disease. Effective, though, this approach may be the resources it demands are high. In areas where people with diabetes is high and disease detection is not dominant, the equipment and expertise required are often lacking. As the number of people who are diagnosed with diabetes grows, the infrastructure and clinical instruments required to avoid vision loss due to Macular Edema will

become even more deficient. The need for an automated method of Macular Edema detecting has long been identified, and very few efforts have made good progress using image classification and machine learning. With fundus images as input, the aim of this project is to develop an automated detection system for Macular Edema.

DEVELOPMENT OF GENERIC AND OPTIMISED ALGORITHM FOR REGRESSION

Machine learning is a growing field of computer science of IT sector that has risen from artificial intelligence. It mostly inculcate pattern recognition and computational learning theory. Machine learning focuses on the development and study of the algorithms that educate themselves and give predictions from and on data respectively. These algorithms work on the basis of a model which is build from the given input intending to make data driven predictions rather than static or structural serial commands. Machine learning focuses computational statistics which is specially used for prediction making. This field has strong connections with mathematical optimisations, which helps to make out various theories, methods and wide applications. Machine learning is generally used where writing algorithms with explicit rules is infeasible. For example, spam filtering, computer vision, handwriting recognition, stock data predictions, search engine, etc. The primary aim of our project is development of a generic algorithm for prediction with optimal parameters' selection. The algorithm intends to use support vectors and normalization for closer predictions and grid search giving out the optimal values of required parameters. This project successfully runs on any datasets providing automation over manual configuration of parameters for regression.

SENDING BULK EMAILS USING AMAZON SES

There are several ways to send bulk email that's not treated as spam. Easy way is to register for a service like Mailchimp. But it is costly. We have created a system that will send bulk emails without being spammed at the reciever end. To send bulk emails we have used amazon ses services because Amazon SES is an outbound-only email service that provides an easy, effective in terms of cost and storage way for you to send email. You can use Amazon SES to send transactional emails,marketing emails, and other types of correspondence emails such as newsletters. You have to pay only for the resources you use, so you can send number of emails as per your choice and wish. The Simple Email Service make easy for you to send mail with min setup and maxl scale ability and speed up .SES is based on the technology used by aws sites around world to send millions of messages a year. Any one can send email without thinking about the heavy lifting of infra management and

storage , configuring your computers for max sending. SES also provides with access to a number of metrics that will provide you with feedback needed to tune your email strategy to max deliverability.

A Self-configurable New Generation Children Tracking System based on Android Mobile Terminals

It enables the user to closely monitor their child's cellular phone activity in a detailed and comprehensive manner. Apart from monitoring the call logs and the messages sent and received, this solution also gives the option of setting up a geofence and a system to trigger an alarm if their ward goes outside the aforementioned geofence. Details of the current and previous locations can be accessed by using the GPS functionality. Various parameters like the call logs, the messages exchanged and their realtime GPS positions are regularly updated in the server database. This information can later be accessed by the appropriate parties. Access is only granted after the user provides the correct username/password combination.

DONATION WEBSITE

This project is based on the development of a user friendly website for the donors which are wishing to donate some money or college beneficial things to our college for the better future of our upcoming generations. This website will help user to donate anything in very simple way. The scope of the project is that as this website is open for the donors the college will get help from the well-wishers of our college. The college will be able to contact the donors in very easy way and donation process will become healthy for both the donor and the college.

ROUTE ALIGNMENT SYSTEM

Route alignment is a complex job as it involves consideration of a number of factors. The conventional route alignment practice is time consuming. Thereby resulting in loss of time and at worst case it may become cause for death. There is need for developing a system that will let to know an individual about the routes before he starts navigation. So that he can reach at his destined place within definite time. In contexts with environmental impact, the choice of routes must address the sensitivity of current and pre-existing conditions. The application reviews geologic, soil and topographic maps as well as available aerial photographs of the area. It will look for conditions that

will require sudden changes in alignment. The sudden changes in route due to natural calamities or human interruption will be notified in topographic map at same instance only. The system has ability to generate precise solutions from certain or approximate information. In this study alignment options are considered combining engineering, social and environment in decision making. The method can be used to justify route alignment choices in environmental impact study analysis.

Web Based Rating Analysis

Many of the online shopping systems(e.g. ipkart,snapdeal) are proposed and used practically due to the rich opportunities provided by the Internet. The traditional online shopping system, however, essentially provides basic browsing via category and "advanced" keyword without any analysis. For customers, this project presents a rating analysis system of online products to show all the possible features of products. Specifically, our proposed system develops a multithreaded crawler to implement web information crawling to implement the data retrieval. The experimental results demonstrate that the proposed system improves shopping efficiencies for the consumers in a visible and advanced way.

PREDICTION SYSTEM

More than 3 lakhs students appear for entrance exam of engineering or medical education. The herculean task begins after the results when they have to fill up the preference form. Due to lack of knowledge though having good marks, many fail to get good college. so there is increasing need of guidance for the same. We are developing a system which will analyze the previous years data (cut-offs) and give prediction about best suited colleges for the corresponding student. Machine learning techniques will be used to analyze the previous data and give predictions on the basis of various categories like marks, SML, etc.

COEP MOBILE APPLICATION

COEP Mobile application helps students stay connected to our college. You will have access to features that make your campus experience more effective, more efficient, and access to your campus events, academic calendar, class schedule, latest campus news, find people in the directory, get in connected instantly, find places on the campus map, send messages, get alerts, and much more. With the use of proposed system students can access the services that they wanted. Using COEP Mobile App student need not have to visit the website every time. They can access the

caught notifications even if they are offline. students will get timely services, whether they are accessing campus news, events or find the resources that they need to achieve educational goal.

WeHealthie Wearables

India online health-care (www.indiaonlinehealth.com) is a portal providing connected health services to patients. The project aims to improve the health of people, especially those from chronic and lifestyle disorders. Wearable technology is latest technology and became very popular day by day. Wearable devices are become very important part of human life as they are related to human health. Basically, this project focuses on wearable devices and data transfer to app and then to server to make easier for people to easily know about their health parameters and be healthy by maintaining proper health. Our project focuses on actual data produced by wearable devices and make that data available to people for easier use through user friendly environment. Initially, wearable devices are used as fitness trackers but recently they can be used for saving lives and for ensuring better quality of life. Main aim is develop a middleware that can interface with multiple wearable devices and then transfer data to an app and then to server running analytical software. Wearable devices are used as a fitness tracker. They however, can be used for more serious purpose of saving lives and ensuring a better quality of life. This project aims to do so. The aim of this project are as follows. Develop a middleware that can interface with multiple Wearable devices via bluetooth, then transfer it to an app, and from there to a central server -running analytics software. Develop an application layer over this middleware for ease of users. This will be presented as a game format to user to bring user attraction. At the start, the user will be presented with the a HRA (health risk assessment) form, from which the user profile will be generated. Based on the profile of the user, a game program will be generated. Different game programs will be generated based on different diseases. For example, a fit user will have fitness program designed, whereas a diabetic will have a different customized program generated. The business rules for this will be obtained from renowned specialist. Once the program is generated, the user can start playing. On activities, and health parameters, user will gain points. As points accumulate, the user can move on to higher level in the games. An interface will be provided to exchange earned points for service provided by different players in the system-for example consultations, health checks, insurance bonuses etc.

Scalable GPU Graph Traversal using CUDA

BFS is applicable in many real life problems. BFS algorithm has vital role in graph traversal, automatic theorem proving. BFS find the minimum number of edges required to reach the given vertex from the source vertex S in graph $G(v, E)$. Time complexity for this problem is $O(V+E)$, when we use optimal sequential solution. By the level synchronization BFS problem can be solved in CUDA implementation. Large graphs are common in scientific and engineering applications consisting operation on million of vertices and edges. Parallel computation is very important to reduce the overall time of computation and to highly increase the speed of execution. Today's Graphics processing units (GPUs) are cheaper than any other system and has highly computational power. Breadth-first search (BFS) is one of the core primitive algorithm for graph traversal. Parallelization of BFS gives more attention towards task management constructed from efficient prefix sum that gives optimal $O(V+E)$ work complexity. In case of diverse graphs this implementation gives excellent performance. This implementation is very fast as compare to the serial implementation.

IDEA Algorithm on GPU using CUDA

To provide network security, various encryption algorithms can be used. Data can be encrypted and sent over network to other machines. These algorithms work can work along with key provided for encrypt and decrypt purpose. Longer the key, better the security. But to encrypt and decrypt data with longer keys, more time is required for computation. Hence our project basically concern with reducing time complexity of block cipher using GPGPU and analyzing the time difference by computing on CPU and GPU. The block ciphers, when subjected to parallelism offered by CUDA, shows high speedups compared to CPUs because of the absence of data dependency in the following data blocks. For optimizing block cipher we are taking advantage of pre-computing substitution table for repetitive parts. This method has advantage in the upgradation on CUDA, because a GPU has relatively large amount of memories to store substitution tables. We will show the original algorithm for cipher first and then illustrate the optimized algorithm.

PERSONALIZED DOCUMENT SIMILARITY

In today's world with ever increasing volume of text resources over internet and digital libraries, organizing these documents with ones likes and interests have become a practical need. In this project, we experiment two well known concept extracting algorithms along with personalizing it to user specific interest and representing it in graphical format. Graphical user interface defines the user

comfort and satisfaction, so it is heart of any software. Hence to make user comfortable with this software the similar documents are represented in graphical format. The software modifies user concepts' weightage from user submitted documents. This makes it easy to read and explore the similar documents guiding the user to widen his/her knowledge.

Intrusion Detection System

Mobile ad hoc network (MANET) is a self-configuring network formed with wireless links by a collection of mobile nodes without using any fixed infrastructure or centralized management. The mobile nodes allow communication among the nodes by hop to hop basis and the forward packets to each other. Due to dynamic infrastructure-less nature and lack of centralized monitoring, the ad hoc networks are vulnerable to various attacks. The performance of network and reliability is compromised by attacks on ad hoc network routing protocols. In a wormhole attack an intruder creates a tunnel during the transmission of the data from one end-point of the network to the other end-point, making leading distant network nodes to believe that they are immediate neighbors and communicate through the wormhole link. In this paper we have analyzed the effect of wormhole attack on AODV routing protocol based Mobile Ad-hoc Network using OPNET simulator using parameter like number of hops, delay, retransmission attempt, and data dropped.

REAL SMART PHONE SYSTEM

Over last decade advancement in technology has fuelled major innovation and development in mobile phone system. In today's life mobile phones are playing an important role in day to day activities. So many applications are developed in different mobile operating systems to help people to do their activities with ease, to reduce their efforts and to entertain people. These applications are very useful for people. But next innovation in mobile phone expects that phones should behave according to the user's behaviour and that is called as real smart phone system. For example, most common activities are user charging mobile when he is in office or changing mobile profile to silent when in a meeting etc. Likewise observing other patterns, collecting information from it and building intelligence to help him with his day to day activities and making a phone really smart is the aim of our project.

Implementation Of Kerberos Protocol Using Public Key Cryptography

Kerberos is a computer network authentication protocol which works on the basis of 'tickets' to

allow nodes communicating over a non-secure network to prove their identity to one another in a secure way. Developers focused primarily at a client server model which provides mutual authentication both the user and the server verify each other's identity. In an open distributed environment in which users at workstations wish to access services on servers distributed all over network. We want servers to restrict the access to authorized users and to be able to authenticate requests for the service. In the environment, a work station can't be trusted to identify its users correctly to network services. An unauthorized user may be able to gain access to services and data that he or she is not authorized to access the service. Kerberos protocol provides a the centralized authentication server whose function is to authenticate servers to users and users to servers ,rather than building authentication protocols at each server, Generally Kerberos builds on Symmetric Key Cryptography. We are adding the Public key cryptography for sending the initial authentication information in Kerberos protocol. It will increase in the security level of the system.

BOOKS++

While reading a book, the best friend we have is our imagination. We create characters, places, movements, feels in our brains to fill in the gaps left by the words. But the words provide us enough raw materials to construct the rest. Yet, we do like books which are nicely illustrated. They provide us with some additional material to build our worlds. Some books like Shakespeare's plays, books by Charles Dickens and ancient classics are annotated with information about places, characters, pictures and so on to make the reading more interesting. What if we could take web pages and augment it with interesting information? About places, people, maps, etc? What if we could augment the reading experience with pertinent emotional content such as images, paintings, poetry and music? What if the content were personalized to the tastes of the reader? What if the content was diverse enough to keep the reader engaged? One could always do this manually. But then where is the fun in that? Our page enhancer system would help to overcome these problems. Using Books++, we create a tool for automatically augmenting the web page content. It would analyze the text of the webpage, and get relevant and varied content from the Internet to augment it. It would also select the content according to its relevance to the text. So this eventually enriches user's reading experience for the travel destination with interesting information and providing emotional content of the place. Thus this tool successfully keeps the user engaged by providing quality content selected from across the Internet.

Doctor Aide (New Doctor Interface Technology)

Importance of Doctor Aide technology is to study the way doctors work, and devise an intuitive way to record their observations using voice recognition techniques. And develop android, hybrid based Mobile application for the same. The Project aims to improve the health of people, especially those with chronic and lifestyle disorders. Meanwhile, there are revolutionary advances in Human computer interaction recently, with voice and handwriting technologies showing great promise. Technologies like Siri, Cortana, Mmodel are revolutionizing voice interactions, whereas technologies such as WACOM are revolutionizing character recognition. The goal of the project is to closely study the way doctors work, and devise a non intuitive way to record their observations on india online health site. This could be through voice recognition technologies, handwriting recognition technologies, a combination of both, or even some other third technologies.