ANNUAL REPORT 2019-20

Explore, Enable, Excel

Institute for Development and Research
in Banking Technology
(Established by Reserve Bank of India)

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Member Secretary
Director, IDRBT

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IMPACT EVENTS

Governor, RBI, visits IDRBT

SHRI Shaktikanta Das, Governor, Reserve Bank of India, visited the Institute on January 20, 2020. Dr. A. S. Ramasastri, Director, IDRBT, warmly welcomed the Governor to the Institute.

Thereafter, the Governor had a one-on-one meeting with the Director. After the meeting, the Governor interacted with the Faculty and Staff members of the Institute and urged them to work in frontier areas of Banking Technology.

The Governor also visited various facilities of the Institute such the IDRBT BankTech Museum and the Institute's Library.

15th International Conference on Information Systems Security

CONTINUING the practice of organising one good international conference every year, the Institute organised the 15th International Conference on Information Systems Security (ICISS 2019) during December 18-20, 2019.

The ICISS, held annually, is a premier international interdisciplinary forum, focused on disseminating the latest research in Information and Systems Security. This conference is of crucial importance for the banking and financial sector since the sector is amongst the most targeted domain of cyber-attacks. So it is necessary that banks are abreast with the latest advances in the security space so as to be well-prepared against these attacks.

Dr. A. S. Ramasastri, Director, IDRBT, started the proceedings by spotlighting the unique positioning of the IDRBT at the intersection of academia and industry and its focus on applied research in the areas of direct relevance to banking, especially the new initiatives such as setting up the 5G Use Case Lab. He also dwelt upon the latest developments in the areas of academics and executive education, with a particular focus on the contributions in the areas of Cyber Security, Analytics, Cloud Computing, Payment Systems, Mobile Banking, Affordable Technologies and the patents the Institute has received on various facets of Cyber Security.

Shri G. Padmanabhan, Non-Executive Chairman, Bank of India delivering the inaugural address at the 15th ICISS

Inaugural Address

Shri G. Padmanabhan, Non-Executive Chairman, Bank of India and former Executive Director, Reserve Bank of India, inaugurated the ICISS 2019. In his inaugural address, Shri Padmanabhan highlighted the following:

- The productivity of banks and financial institutions has increased multi-fold after inclusion of cyber in their delivery channels. But it has also resulted in various threats and challenges to ensure safety for wired as well as wireless transactions. The Banking and Financial Sector is the most vulnerable and most targeted as money is involved
- The challenge of protecting open and faster delivery channels riding on blockchain coupled with 5G gets immense when "walls and roof" of banks are vanishing.
- In the Indian context, when 3-4 vendors have rolled out banking solution for the entire banking industry, if a security lapse is exploited by one rogue, then almost all banks using that solution become potentially vulnerable.
- In the year 2018, cyber-attacks on India had increased by over 100% over the previous year as against the corresponding global increase of 35%. India was the second most targeted country for cyber-attacks in the world, after the US.
- Threat hunting, segmentation of networks,

Dr. Reza Shokri, National University of Singapore, speaking on Machine Learning.

regular data backup, implementation of multifactor authentication, finetuning SoC alerts can help in containing cyber-attacks better.

- Countering cyber threats calls for dedicated and continuous research to monitoring evolving threats and counter measures. The financial sector depends heavily on academia for this. I suggest that the financial sector come together to fund such research on an ongoing basis. This would enable the institutions to be proactive rather than reactive in dealing with cyber-attacks.
- Ideally, the solutions emerge from academia, which are then delivered to banks through fintechs and IT companies. It is in this context that institutions like IDRBT, which are at the intersection between industry and academia are playing an important role.

A galaxy of renowned international researchers in the area of Information and Systems Security including the following participated and delivered keynote talks:

- Karthikeyan Bhargavan, directeur de recherche, Institut national de recherche en informatique et en automatique (INRIA), Paris, on "Secure Messaging: Towards Verified Standards and High Assurance Implementations."
- Krishna P. Gummadi, Head, Networked Systems Research Group, Max Planck Institute for Software Systems, Germany, on "Privacy, Fairness, Transparency, and Abuse of Targeted Advertising on Social Media."
- Reza Shokri, Assistant Professor of Computer Science at the National University of Singapore on "Trusting Machine Learning: Privacy, Robustness, and Interpretability Challenges."

This three-day conference was preceded by a two-day tutorial on December 16 - 17, 2019 on Digital Forensics – Process, Tools and Challenges, Capitalising on DevOps and Android Malware Prediction using Machine Learning Techniques.

Seventeen research papers covering the areas of Smart Contracts, Formal Techniques, Access Control, Machine Learning, Distributed Systems, Cryptography, Online Social Networks and Images and Cryptography authored by leading researches from across the globe including Moscow State University, Russia; University of Kentucky, USA; Norwegian University of Science and Technology, Norway; University of Cauca, Columbia; University of Minho, Portugal; Peking University, China, were presented. The acceptance rate of the conference was 23.29%.

The IDRBT, this year, instituted the "IDRBT Best Practice Paper Award" to encourage and tap into the novel ideas presented at ICISS. The paper titled "Policy Reconciliation and Migration in Attribute Based Access Control" authored by Gunjan Batra, Vijayalakshmi Atluri, Jaideep Vaidya from Rutgers Business School and Shamik Sural from IIT Kharagpur, won the inaugural IDRBT Best Practice Paper Award.

Payment & Settlement Systems Innovation Contest

PAYMENT and Settlement Systems are witnessing rapid changes with the forces of innovation at play. A goal of the Reserve Bank of India is to universalise digital payments and provide for payment systems, which are affordable, available round the clock and accessible to everyone. This can be achieved by expanding the payment ecosystem and encouraging further innovation in products and systems.

In order to provide a platform to showcase innovations and foster new developments by entrepreneurs, start-ups and similar entities in the payments space, the Reserve Bank of India decided to conduct an Innovation Contest on Payment and Settlement Systems. The task of conducting the Payment and Settlement Systems Innovation Contest (PSSIC) was entrusted to the Institute.

The PSSIC was designed to provide a platform to encourage, recognise, promote and display innovations by individuals, groups, entrepreneurs, companies, start-ups and similar entities in the Payment and Settlement Systems arena. The Institute's call for participation in the PSSIC evoked a very good response with submissions coming in right from companies in the payment systems space to individuals, who are focussed on expanding the horizons of digital payments.

Team from Mastercard Technology Pvt. Ltd., presenting their innovation

A team of experts scrutinised the proposals received taking into account the relevance of the submission as well as extent of innovation and shortlisted the following seven innovations for the final stage of the contest:

S. No.	Name of the Innovation
1	Distress Signal Enablement in Payment Transaction
2	A Secure True P2P Payment Solution
3	Enabling Feature Phone Payments via Sound Tech
4	All-in-One Card & Card-less
5	Yoti Digital Identity App
6	Innovative Settlement Modes
7	Intelligent Dispute Management & Settlement System

Taking the process forward, the Institute organised the Payment and Settlement Systems Innovation Contest on February 25, 2020. Speaking on the occasion, Dr. A. S. Ramasastri, Director, IDRBT, stressed on the need to tap innovations in the payments space, especially those that address challenging situations like poor or no network connectivity. Major differences in language, literacy levels and trust in digital systems needs to be bridged through technological innovations. Urban-centric solutions are a good beginning but now, we need to move on to address issues of the hinterland. The good solutions presented at the PSSIC, need to be taken forward so that they can influence the country and world at large, he added.

Keynote Address

Thereafter, Shri S. Ganesh Kumar, Executive Director, Reserve Bank of India, delivering the keynote address, focused on the information technology related threats in the rapidly evolving banking ecosystem. He emphasised that given India's demography is becoming increasingly young, banking solutions should cater to them. Some of the characteristics that the young look for are comfort, convenience and confidence. Banks are increasingly challenged to get a balance between the three and that's where we need innovation.

Thereafter, all the seven teams presented their innovations. An Eminent Jury consisting of Shri S Ganesh Kumar, Executive Director, Reserve Bank of India; Smt. Sunita Handa, Chief General Manager, IT Channels and Operations, State Bank of India; Dr. Santanu Paul, Managing Director & Chief Executive Officer, TalentSprint and Dr. C. Krishna Mohan, Professor, Indian Institute of Technology, Hyderabad adjudged these innovations.

Shri S. Ganesh Kumar, Executive Director, RBI delivering the Keynote address during the contest

And the Winners were:

- **First Prize of Rs 10 Lakh:** Innovation Titled "Enabling Feature Phone Payments via SoundTech" by Team ToneTag
- **Second Prize of Rs 5 Lakh:** Innovation Titled "Yoti Digital Identity App" by Team Yoti Biometri Identity Private Ltd.
- **Third Prize of Rs 2 Lakh:** Innovation Titled "All In One Card and Cardless Payments" by Team Kashware.

Winners of the Payment and Settlement Systems Innovation Contest with Shri S. Ganesh Kumar, ED, RBI, Dr. A. S. Ramasastri, Director, IDRBT and the Jury Members

Conference on Payment and Settlement Systems Vision 2021 and Deepening of Digital Payments

THE Reserve Bank of India & IDRBT jointly organised a Conference on "Payment and Settlement Systems Vision 2021 and Deepening of Digital Payments" on October 16, 2019.

The conference started with the opening remarks by Dr. A.S. Ramasastri, Director, IDRBT. Shri S. Ganesh Kumar, Executive Director, Reserve Bank of India, stressed that since obsolescence of technology is faster than the rate at which innovations happen, the bankers need to get an idea as to what has to be done to their banks, which involves:

- Competitive Differentiation
- The difference between two banks is what products and how they way they offer it to the customers
- Providing a worthy experience to the customer that will make the customer continue with the bank.

Shri P. Vasudevan, Chief General Manager, DPSS, RBI discussing the Payment & Settlement Systems Vision 2021 and Deepening of Digital Payments

Shri Dilip Asbe, Chief Executive Officer, NPCI, speaking on New Developments in Retail Payments

He also highlighted that "retaining customer attention is a challenge and profits of banks will be centered around Payment Systems, so there is a need to come out with new and innovative Payment Systems on a continuous basis.

Shri Dilip Asbe, Chief Executive Officer, National Payments Corporation of India, spoke on New Developments in Retail Payments, covering Regulatory Initiatives such as Regulatory Sandbox, 24/7 NEFT, White Paper for Regulation of Payment System, Waiver of charges, etc.

Shri P. Vasudevan, Chief General Manager, DPSS, RBI & his Team, lead a discussion on Payment and Settlement Systems Vision 2021 and Deepening of Digital Payments, which helped provide clarity on the way forward. Dr. N.V. Narendra Kumar, Faculty, IDRBT, spoke on Evolving Technologies in Payment Systems.

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NEW INITIATIVES

IIBF-IDRBT Research Fellowship in Banking Technology

In a joint initiative aimed at enabling talent in the area of Banking Technology, the Indian Institute of Banking & Finance and IDRBT have together launched a "Research Fellowship in Banking Technology."

The fellowship will sponsor a technically and economically feasible research project, which has the potential to contribute significantly to the Banking and Financial Sector in the areas of Cyber Security, Analytics, Mobile Banking, Emerging Technologies, and Payment Systems.

The selected research project carries a cash award of Rupees Five lakhs and is expected to be completed in six months. The inaugural round of the Fellowship was announced in October 2019.

Launch of e-Programmes

Given the Covid-19 situation, the Institute was not able to offer classroom-training programmes since late-March 2020. However, refusing to be weighed down by the pandemic, the Institute on a priority basis worked on and introduced an e-Learning channel for training programmes in the first week of May 2020. This initiative of the Institute, launched quickly, aimed to ensure that the Indian Banking and Financial Sector continuously gets to upgrade its technology skills, especially given the increased reliance on technology and digitisation during the pandemic.

These e-Programmes provide the required learning inputs through online teaching, reading material, videos, webinars, assignments, quizzes, online interactions and clarifications. The e-Programmes also included quite a few programmes focused on topics that deal with technology issues arising due to Covid-19 such as ensuring business continuity.

In the months of May and June, the Institute conducted 13 e-Programmes including one customised e-programme for Canara Bank, in the areas of IT Project Management, Re-envisioning Digital Banking Systems, Recent Cyber Crimes and Defences, Continuous Security Validation, Technologies for Customer Life Cycle Management, RBI Guidelines on Cyber Security, Trends in Mobile Payments and Social Media Banking, Fundamentals of Open Source Technologies, Introduction to Fraud Analytics, Introduction to Technologies for Doorstep Banking and Fundamentals of Wi-Fi Security; and trained 265 bankers.

Webinar Series for Board Members

Another new initiative the Institute launched during the pandemic times is the Webinar Series for Board Members. As the Institute started offering e-programmes, we began receiving requests from bank directors to consider offering webinars on various areas of immediate relevance to banks.

Guided by this input, the Institute started organising a webinar every month for bank directors on topics of direct relevance to the banking and financial sector, bringing in some of the best minds in the sector to share their thoughts.

Starting off in May 2020, the Institute organised the following two webinars:

- **HR Related Issues in Banks' BCP During Pandemics** by **Shri H. R. Khan,** Former Deputy Governor, RBI, on May 15, 2020.
- **Cyber Security: During Pandemic and Beyond** by **Shri R. Gandhi,** Former Deputy Governor, RBI, on June 12, 2020.

Handbook on APIs

EVERYTHING that goes into making a bank digital like delivering new customer experience, building software ecosystem and moving to multi-cloud environment involves APIs. APIs (Application Programming Interfaces) are becoming, if not already become, the de facto standard for building and connecting applications.

Dr. A. S. Ramasastri, Director, IDRBT, releasing the Handbook on APIs in a CISO Forum meet held at IDRBT

Banks have understood that APIs are not just integration technology to connect applications and data but as software products that empower developers to unlock new digital business models and opportunities. Indeed, the adoption, design, and management of APIs are increasingly driven not by IT middleware requirements but by strategic business goals relevant to senior and top level management of banks. Moreover, Open Banking relies heavily on APIs. It is threatening long-established banking practices and procedures. And banks are converting the threat into a great opportunity.

It is in this background the Institute attempted to put together all relevant information on APIs in this handbook. This handbook, serves as a good reference material for banks and software companies that are working with banks in development of APIs. The handbook was released on August 20, 2019 during the CISO Forum meeting.

Staff Paper Series on FinTech

BANKS and FinTechs have started collaborating closely, paving the way for innovative banking products and services. An entire ecosystem led by regulators as well as both central and state governments has been evolving. The ecosystem comprises academic institutions, incubators, accelerators, start-ups, major IT companies and funding institutions.

Some of the major areas in which FinTechs have been working include payment systems, mobile banking, analytics, artificial intelligence, cyber security, customer interface, risk management and blockchain technology. The Institute's researchers

Dr. A. S. Ramasastri, releasing the Staff Peper Series on FinTech

are studying these areas. Given the evolving Fintech ecosystem, we have put together the research studies undertaken by the Institute in the areas relevant to FinTechs.

The Staff Paper Series on FinTech covers the areas of Artificial Intelligence, Blockchain, Security and Financial Inclusion, encapsulating the present status of academic work in the concerned areas along with opportunities for FinTechs to exploit them. The Staff Paper Series on FinTech was released during the Fourth FinTech Forum Meet, held on August 05, 2019.

Joint building of IDRBT and UoH

A Joint Building of the IDRBT and University of Hyderabad was inaugurated on February 20, 2020 at the University of Hyderabad (UoH) campus. Shri B. V. R. Mohan Reddy, Chairman, Board of Governors, IIT, Hyderabad inaugurated it in the presence of Dr. A.S. Ramasastri, Director, IDRBT and Prof. Appa Rao Podile, Vice-Chancellor, UoH.

The IDRBT in collaboration with the SCIS, UoH, has been offering an M.Tech. programme in Information Technology, with specialisation in Banking Technology and Information Security, since 2001, to create a set of IT professionals with specialised skills for the Indian Banking and Financial Sector. The Institute's Faculty handle the core Banking Technology courses and help in developing niche technologies and creating joint research opportunities in areas related to Banking Technologies. This symbiotic relationship has resulted in building a collaborative space for joint research and academics.

Shri B. V. R. Mohan Reddy, Chairman, Board of Governors, IIT, Hyderabad, inaugurating the Joint Building of IDRBT & University of Hyderabad

After the inauguration, Dr. A. S. Ramasastri spotlighted the long-term relationship between UoH and IDRBT and Prof. Chakravarthy Bhagvati, Dean, School of Computer and Information Sciences, UoH, made a brief presentation about the school. The Chief Guest, Shri B.V.R. Mohan Reddy highlighted the increased role of computing in the future 'Education 4.0' which emphasises customised and individualised quality learning for large numbers of people, and requires re-imagining classrooms and labs. He stressed on the need to continue leading by example with state-of-the-art research and innovative teaching methods.

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RESEARCH & DEVELOPMENT

THE Research Team of the Institute is consistently working towards realising the vision of the Institute, which is "to be the premier and preferred Research and Development Institution on Financial Sector Technology and its Management, working at the intersection of Banking and Technology for the Indian Banking".

The Institute's six research centres have been carrying out Applied Research in the frontier areas of Banking Technology. This chapter presents the details of the major research work carried out during the year:

Research Centres

Centre of Excellence in Analytics

The Centre's research and training activities spawn the entire spectrum of Analytics, AI/ML applied to CRM and non-CRM related areas in banks. During the year, the centre apart from working on the externally-funded research project titled "Developing Data Science Framework, Architecture, and Methodology for Fraud Detection" in collaboration with CDAC, developed Chatbot 2.0, an Android application, as a question and answering system for banking queries intelligently through NLP.

The centre conducted training programmes on Analytics for SEBI, Big Data Analytics for NABARD and Big Data Analytics with Hadoop and Spark for various banks. The Centre also offered e-programmes on Technologies for Customer Life Cycle Management and Technologies for Fraud Analytics. A meeting of the Chief Analytics Officers Forum was held on December 5, 2019.

Centre of Excellence in Cyber Security

During the year, the Centre conducted four Cyber Security Drills in August and November 2019 and in February and May 2020 with participation of 49, 52, 48 and 30 banks respectively. This year, four CISO Forum meetings were held -- in August 2019 with 54 participants at IDRBT; November 2019 at Oriental Bank of Commerce, Gurgaon with 53 CISOs; February 24-25, 2020 at IDRBT with 48 participants and an online meeting on May 29, 2020 owing to the pandemic.

The centre conducted Executive Development Programmes on Cyber Defence for Banks, Website Security, Red Team and Blue Team Exercises and Secure Web Application Development. The centre also conducted e-Programmes on Recent Cyber Crimes & Defences (twice), RBI Guidelines on Cyber Security and a customised programme on Secure Coding Practices for Canara Bank. The centre also manages the IB-Cart Incident Broadcast on an ongoing basis.

Centre for Mobile Banking

During the year, the Centre tested mobile applications for State Bank of India, Union Bank of India, Allahabad Bank, IndusInd Bank, IDCB Bank as well as the following Apps -- IFTAS RBI Sammelan, IFTAS RBI BCP, Adarsh Bank Mobile Banking, Adarsh Bank Tollfree Services, KVB – Dlite, KVB E-Book, KVB UPay, Syndmobile, OBC-mPAY and Central Swa-Darpan. The centre also created an app testing environment for the iOS platform.

The centre organised executive development programmes on Mobile Banking Security and Testing; Mobile Technologies, Social Media, and Internet of Things; Registration Authority Operations,

Information Systems Control and Audit, IT Vendor Management, and Wi-Fi Security Fundamentals. The centre also conducted five workshops on the New IDRBT CA Application. Three M.Tech. students and one PGDBT student carried out their projects in the Centre during the year.

Centre for Affordable Technologies

The centre set up Fineract (Open Source CBS) to use as a test bed for Fintech activities. Using SDR and open source solutions, the centre created a mini-eNB. During the year, the centre carried out rural connectivity related experiments on 5G and continuously mentored Fintechs.

The centre developed the IBFX (Fintech) portal to facilitate interaction between FinTechs, which is now being used by over a hundred FinTechs. The Centre also organised a workshop on Financial Inclusion on November 29, 2019 and the second meeting of the Fintech Advisory Committee was held on August 05, 2019.

The centre organised executive development programmes on IT Project Management, Technologies for Financial Inclusion, Artificial Intelligence Based Technologies for Smart Banking, Open Source Technologies for Banks, Data Science in Banking and Finance, and Introduction to Technologies for Doorstep Banking.

Centre for Cloud Computing

During the year, the centre set up the SaaS Cloud Platform, set up DevOps environment on Cloud, implemented VM migrations in cloud data centre using OpenStack platform; prepared a document on comparison of open source software for building private cloud as well as a document on comparison of public cloud providers on different services.

The centre conducted Executive Development Programmes on Virtualisation and Cloud Computing, Cloud Security and Privacy, Data Centre Management, Docker, DevOps, Network Security, Secure Coding Practices, and Secure Operations Centre.

This year, three M.Tech. students completed their projects from the centre and one research fellow submitted his Ph.D. thesis.

Centre for Payment Systems

During this year, the centre implemented the classic BFT consensus algorithm due to Castro & Liskov, developed the other basis components needed to

IDRBT Receives New Patent

THE Institute has been granted an US Patent (Number 10498537) for its work on "System and Method for Providing Secure Collaborative Software as a Service (SaaS) Attestation Service for Authentication in Cloud Computing," on December 12, 2019.

With a view to enable scalability and availability with the security services in a SaaS delivery model, the patent describes an authentication framework that works as a collaborative service attestation for authentication in cloud computing. The described framework is facilitated with a novel hierarchical certificateless aggregate signature scheme to provide authentication and non-repudiation for SaaS.

The work for the patent was carried out by Dr. G. R. Gangadharan and Deepnarayan Tiwari.

complete the blockchain platform such as membership service and data service. The full prototype platform including two use-cases are in a demo-able state.

The centre arrived at a modular program that correctly implements (provable by establishing correspondence with the declarative spec that has been proved correct) the BFT algorithm; interacted with the banking community to initiate work to turn the prototype into a full-fledged system and is continuing research on offline payments.

The centre organised executive development programmes on Payment Systems - Current Trends and New Initiatives and Re-envisioning Digital Banking Systems.

Research Projects

Besides continuing work on the various ongoing projects, the Faculty of the Institute worked on the following research projects during the year:

5G Use Case Lab for Banking and Financial Services [Sponsored by Dept. of Telecommunications & Dept. of Financial Services, Govt. of India]

The Department of Telecommunications and Department of Financial Services, Government of India, has awarded the IDRBT a major research project on "5G Use Case Lab for Banking and Financial Services". The primary aim of the project is to explore and develop Use Cases of 5G for Banking and Financial Services.

With a primary focus to carry out this transformational research project, the IDRBT has set up the 5G Use Case Lab for Banking and Financial Services. The lab will identify India-specific use cases of 5G in Banking and Financial Services sector and would support the Banking and Financial Services to implement 5G technologies on par with developed countries. Considering that India has the 2nd largest mobile penetration in the world and has a diverse digital divide, the security gaps in 5G technologies and services would also be identified along with 5G use cases.

The lab would collaborate with Financial Services organisations, Service Providers, Academic Institutions and most importantly, Startups, to promote agility and innovations for enhanced customer experience. The lab will work on Financial Inclusion and rural connectivity, Futuristic ATM/Mobile Banking, Claim Processing, Fraud detection, enhanced customer experience leveraging IoT, Distributed Ledger, VR and AR, AI and ML, Network Slicing technologies and Security technologies to ensure trust is built into the technology from the day of 5G adoption.

During the first year, the primary research focus is on QoS-Net-Slicing, QoS Security, and Algorithms and Models that are related to 5G Use Cases.

Development of Novel Algorithms for Banking

This project focuses on enabling automatic cheque processing and field identification using DL hybrid architectures. The following areas of work have been completed - identifying log of the cheques with YOLO framework, offline character recognition with high accuracy on benchmark datasets with transfer learning from ResNet. Further, face recognition is also accomplished with high accuracy on benchmark datasets using modified FaceNet.

Development of Novel Chatbot for Banks using DL

The aim of this project is development of novel algorithms chatbot using novel DL algorithms for banking. The chatbot will be particularly useful to small banks.

The Dialog Manager in Chatbots via Hybrid Deep Learning Architectures has been developed. Learning from previous conversations is achieved with hybrid, hierarchical ML-DL architecture with seq-to-seq models. User feedback is also incorporated.

Novel Financial Time Series Forecasting Models

This project aims to develop novel financial time series forecasting models for macroeconomic indicator forecasting, ATM cash withdrawal forecasting, etc.

We achieved macroeconomic time series forecasting with both point forecasts and prediction intervals with better accuracy than extant models. ATM cash withdrawal forecasting was accomplished by including chaos and day-of-the-week dummy variables using ML and DL techniques.

App Development on Mobile Platform using IOT devices and sensors for managing, auditing and controlling human resources

This project is useful for banks and e-government projects for managing, auditing and controlling human resources. Using the application, government and banking organisations can manage, audit and control human resources, including staff deployed on onsite and outdoor projects. The Demo App is developed and prototype tested in Lab environment.

Hardware Trojan Detection in PCBs Using X-Ray Images [DRDO funded project in collaboration with Indian Statistical Institute, Kolkata]

The Defence Research and Development OrganiSation (DRDO) has awarded the research project titled "Hardware Trojan Detection in PCBs Using X-Ray Images", to the Institute in collaboration with Indian Statistical Institute, Kolkata.

The project aims to detect malicious components (trojans) in the hardware using x-ray images of the hardware. In the context of this project, hardware refers to printed circuit boards (PCBs). A reconstructed model of the test PCB will be compared against a reference model to find out the additional/malicious components in the hardware so as to deliver a method based on structural analysis to detect if a test PCB contains malicious additional hardware component. In the wake of several cyber attacks using hardware trojans, this project aims to make important contributions in devising a novel method for hardware trojan detection.

Detecting Alterations in Hand-written Documents

This work intends to propose mechanisms for detecting tampering of hand-written documents. Alterations of handwritten documents can be classified into two categories: (a) addition of new words and (b) alteration of existing words. In this work, we propose methods to detect both kinds of alterations. The proposed methods relate to pen ink analysis as part of hand-written document forensics. These methods are helpful in detecting forgery of a hand-written document, such as a bank cheque or any other form of hand-written document.

Towards Building a Model Blockchain Platform

The objective of this project is to build a permissioned-BCT platform that enables secure development of distributed applications as needed.

As part of the project, explored the foundational concepts, applications and detailed technical aspects of Blockchain technology platforms including Hyperledger Fabric, Corda, EVBF (Infosys), Multichain and Quorum. Conducted workshops, brainstorming sessions and customised sessions on blockchain technology. Worked on developing blueprint for a blockchain platform useful for banking sector and beyond. Successfully implemented the classic BFT consensus algorithm in a modular and provably correct manner. Refined the blueprint with use case specific aspects, built a working prototype, and use-cases – C-KYC and Trade Finance. Prepared a research report on digital asset management using blockchain technology.

Ms. Aparna Kumar, Chief Information Officer, HSBC, delivering talk on "Future Technologies in Banking"

Financial Text Regression

Financial texts are freely available on Internet in huge amounts. By keeping a track of this data, one can observe the risk element, which in turn, allows an individual to predict the future risk too. This study on the financial textual content can further help in predicting the credit score of a person. As part of the project, implemented convolution neural network and recurrent neural network for the prediction of stock return volatility and investigated how much the historical data affects prediction task.

Voice-based Chatbots

The use of voice authentication for banks provides customers with an additional, user-friendly way to authenticate themselves, thus delivering a consistent and superior user experience while providing banks with strong authentication across channels. Lower back office costs to authenticate customers and customer convenience in case they forget their account number or PIN are other benefits.

As part of the project, implemented a basic voice-based chatbot system, which takes simple queries in English language and responds. Used Python environment for the implementation. Reproduced the scenario in different languages (Telugu, Tamil, Gujarati, etc.) and extended the scenario to support multiple languages at once, with an easy option for the user to choose a language of her preference at the very beginning of the call.

Secure Authentication in IoT devices for Smart Banking

The objective of this project is to design a protocol for remote user authentication for digital account opening with bank and initiating successful payments using wearable device.

In this project, three phases are designed for wearable device registration and authentication of user and her/his wearable device with banks server followed by a payment protocol between two registered entities acting as a merchant and a client. The protocols are deployed and their computation costs are analysed per operation.

A Survey on Cloud Deployment Models on Remote Authentication Mechanism using Kerberos

The goal of this research project is to understand the role based access control policies set up in OpenStack where members of a bank belonging to different sections must gain controlled access as well as obtain the remote client-server authentication mechanism in user verification using Kerberos protocol in cloud.

In this project, a study on open-source cloud computing tools is conducted and their essential features are compared based on authentication process, security, and access control most specific to the usage of Kerberos protocol. This was followed by an implementation of Kerberos protocol in OpenStack cloud model for client-server authentication and testing the role based access control feature of OpenStack for analysis.

Developing Novel Security Algorithms for Consumer Electronics Hardware for building an Unthreatened IoT Enabled Smart Banking Environment

Internet-of-Things (IoT) enabled smart banking is the future of banking technology where the banks can anticipate the requirements of customers and offer necessary services/solutions. So banks need to collect lots of real-time data from their customers to analyse. The wearable and mobile devices used by customers are the primary sources of that.

Moreover, banks also provide their services/ solutions through modern Consumer Electronics (CE) hardware. For this reason, billions of hardware devices remain interconnected in an IoT-enabled smart banking environment. Therefore, launching a successful attack on one of these devices may put the whole environment at stake. This necessitates the protection of IoT devices (wearable and mobile devices) regardless of their size, to implement a secure IoT enabled banking system.

The objectives of the project are to develop a novel non-signature based ownership attack resilient security algorithm for CE hardware used in banking technology; develop a novel high-level transformation based reverse engineering attack resilient security algorithm for CE hardware used in banking technology; and develop a novel light-weight cryptographic framework based removal and SAT attack resilient security algorithm for CE hardware used in banking technology.

This project will help banks and other financial institutions to host a secure and robust IoT-enabled banking environment by mitigating several hardware attacks (such as ownership attack, Trojan attack, reverse engineering attack, removal attack). This will encourage the Indian banks to move from core banking solutions to smart banking services.

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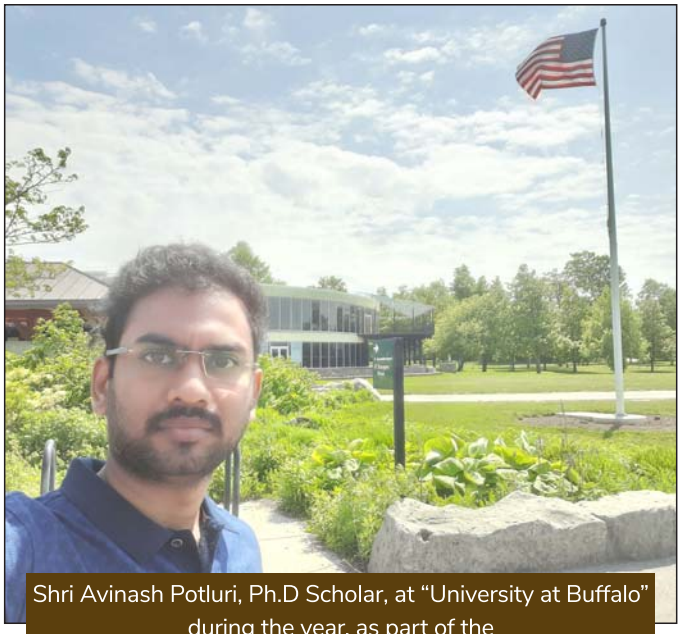
ACADEMIC PROGRAMMES

Ph. D. Programme

THE Institute offers Ph.D. programmes in various areas of Computer Science directly relevant to Banking Technology in collaboration with the following premier institutions:

- University of Hyderabad (since 1999)
- National Institute of Technology, Warangal (since 2015)
- National Institute of Technology, Trichy (since 2016)
- Indian Institute of Technology, Hyderabad (since 2018)

During the year, three Research Fellows submitted their Ph.D. thesis, and their details are hereunder:



Shri Avinash Potluri, Ph.D Scholar, at "University at Buffalo" during the year, as part of the Institute's Student Exchange Programme

S. No.	Name of the Research Fellow	Area	Supervisor
01	P. Praveen Kumar	Efficient and Secure Ciphertext-Policy Attribute-Based Encryption Schemes for Big Data Access Control in Cloud Storage	Dr. P. Syam Kumar
02	Ravi Uyyala	Prediction Error Expansion Based Reversible Watermarking for Images	Dr. Rajarshi Pal
03	Gutha Jaya Krishna	Evolutionary Computing applied to solve some Analytical and Operational problems in Banking, Financial Services and Insurance	Dr. V. Ravi

During this year, two Research Fellows from University of Hyderabad and one Research Fellow from IIT Hyderabad joined for Ph. D. with the Institute. Further, 27 Research Fellows are currently pursuing Ph.D. in the Institute. The details of these scholars, their guides and areas of research is in **Annex – A.**

Ninth IDRBT Doctoral Colloquium

The Annual IDRBT Doctoral Colloquium is an initiative aimed at discovering and exploring emerging areas of research in various domains of technology, sharing knowledge and forming a network of technology researchers. It intends to create a platform to collaborate, and exchange research ideas, thereby exploring the opportunities for innovation in the Indian Banking and Financial Sector.

Taking this initiative forward, the Institute organised the Ninth IDRBT Doctoral Colloquium on December 09, 2019. Eleven Research scholars from reputed institutions like IITs, ISI and IIITs, presented their research in the Colloquium. The specifics of the scholars and the topic on which they dwelt on are presented in **Annex. B.**

Awards and Evaluation

A Jury consisting of Dr. Shalabh Bhatnagar, Indian Institute of Science, Bangalore; Dr. Kannan Srinathan, International Institute of Information Technology, Hyderabad and Dr. Chakravarthy Bhagvati, University of Hyderabad, evaluated the paper presentations on the parameters of Originality, Depth of Work (Modelling, Design, Experimentation, Results), Technical Content (Models, Optimization, Technologies, Analysis), Presentation (PPTs, Graphs, Explanations, Language, Clarity), Relevance (Applicability, Modernism) and Correctness of Work (Correct, Complete, Gaps).

The Winners

- First Prize of INR 1 lakh: Ms. Ankita Mandal, Indian Statistical Institute, Kolkata, for her contribution entitled Scalable Regularized Canonical Correlation Analysis for Multimodal Omics Data.
- Second Prize of INR 50,000/-: Mr. Daksh Thapar, Indian Institute of Technology, Mandi, for his contribution entitled Multi-view and cross-angle gait based behavioural biometric recognition system using Deep Learning.
- Third Prize of INR 35, 000/-: Mr. Hridoy Sankar Dutta, Indraprastha Institute of Information Technology, Delhi, for his contribution entitled CoReRank: Ranking to Detect Users Involved in Blackmarket-based Collusive Retweeting Activities.

Winners of the Ninth IDRBT Doctoral Colloquium (LtoR) Mr. Hridoy Sankar Dutta, IIIT Delhi, Mr. Daksh Thapar, IIT, Mandi and Ms. Ankita Mandal, ISI, Kolkata, with Dr. A. S. Ramasastri, Jury members and coordinators of the colloquium

Post Graduate Diploma in Banking Technology

THE Post Graduate Diploma in Banking Technology (PGDBT) is the Institute's flagship programme. It is a unique one-year fulltime programme designed to meet the demand of the Indian Banking and Financial Sector for high-quality technology talent. The programme focuses on current as well as emerging technologies that can spearhead the technology initiatives of banks and financial institutions. The fourth batch of PGDBT commenced on July 01, 2019.

100% Placements

Continuing the cent percent placement standard set by the Institute, as in the case of the first three batches, the Institute is happy to report that the Institute has achieved 100% placements for the fourth batch too.

The Institute facilitated placements for the fourth batch of PGDBT by inviting prospective employers to the Institute. As this programme is specifically designed to meet the demands of the Banking and Financial Sector, all successful students were selected by banks. The students of this batch were recruited by the following banks:

- Kotak Mahindra Bank
- The Federal Bank Ltd.
- The Karur Vysya Bank Ltd.
- City Union Bank Ltd.

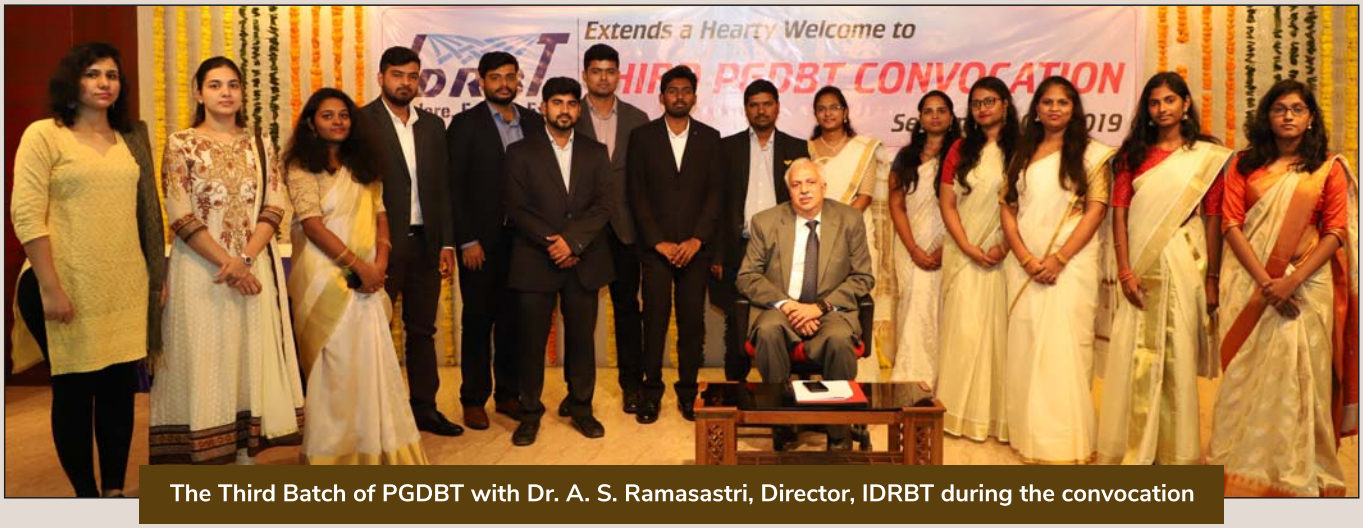
The details of the PGDBT students during the year and details of their placement is in **Annex. C.**

Fourth Batch of PGDBT

PGDBT Convocation

The convocation for the third batch of the Institute's Post Graduate Diploma in Banking and Technology (PGDBT), which completed their course requirements in June 2019, was held on September 05, 2019.

Dr. A.S. Ramasastri, Director, IDRBT, presented the Diplomas, to the successful students. Speaking on the occasion, he advised the students to keep their unwavered focus on continuous learning, for change is a constant in technology and it becomes obsolete quickly. Exhorting them to work hard and contribute well to the banks which have recruited them, he pointed out that being students of IDRBT, banks have high expectations from them, and they need to live upto them.



The Third Batch of PGDBT with Dr. A. S. Ramasastri, Director, IDRBT during the convocation

Dr. A.S. Ramasastri Gold Medal

With a view to encourage the PGDBT students to raise the bar and perform better, the Dr. A. S. Ramasastri Gold Medal for the topper of the PGDBT Programme, was instituted during the year. The funds for this medal and accompanying citation were contributed by Dr. A.S. Ramasastri, Director, IDRBT.

Shri Sreekanth N, won the inaugural Dr. A.S. Ramasastri Gold Medal for scoring the highest marks in the 2018–2019 batch of PGDBT.

Shri Sreekanth N, topper of the PGDBT 2018-19 batch receiving the Dr. A. S. Ramasastri Gold Medal

M.Tech. 2019-20

The IDRBT in collaboration with the University of Hyderabad (A Central University) offers a unique M. Tech. in Information Technology since 2001. This multi-disciplinary programme seeks to merge the new and emerging technologies in the arena of Information Technology with the domain expertise in the ever-changing field of Banking and Financial services. This four-semester course, is designed to impart in-depth knowledge and expertise to the students through innovative learning, supported by high calibre research.

The M. Tech. (IT) Batch of 2019 – 20 had 20 students. The second year of programme is dedicated to carrying out projects and the specifics of these projects is in **Annex. D.**

Invited Lectures

As part of its efforts to share and spread the best that is being thought and researched in areas of Institute's interest, the following invited lectures were delivered during the year at the Institute.

- Shri. Shridaran C, General Manager (Retd.), Canara Bank, delivered a talk on "Auditing" on July 24, 2019
- Shri. Saran K Joseph, Asst. Vice President-IT, Federal Bank, delivered a talk on "Digital Banking" on August 20, 2019
- Shri. Balaji Venkateshwar, Chief Information Security Officer, IDFC First Bank Ltd., spoke on "Cyber Security and Cyber Defense" on December 04, 2019
- Ms. Aparna Kumar, Chief Information Officer, Hong Kong and Shanghai Banking Corporation, delivered a talk on "Future Technologies in Banking" on December 04, 2019
- Shri. Tejas Mehta, Chief Technology Officer, RBL Bank Ltd., spoke on "Architecture of Banking Technology and Functions" on December 05, 2019
- Shri. A. P. Hota, Independent Director, The Federal Bank Ltd., delivered a talk on "Digital Banking: Yesterday and Tomorrow" on December 11, 2019

Shri. A. P. Hota, Independent Director, The Federal Bank Ltd., speaking on "Digital Banking: Yesterday and Tomorrow"

- Prof. Sudhir Dixit delivered a talk on "What comes next? Is there a need for a new generation after 5G: A Reality Check? and Internet for all to Bridge the Digital Divide and to Enable Digital (Cashless) Economy" on January 13, 2020
- Dr. C. Mohan, IBM Fellow, IBM Almaden Research Center, USA & Distinguished Visiting Professor, Tsinghua University, China, delivered a talk on "Blockchain Technology: Myths, Reality and Applications", on January 23, 2020
- Shri. Premal Gandhi, Security Solution Architect, AISPL, delivered a talk on "Security and Compliance in Cloud" on January 31, 2020
- Ms. Kalpana Pandey, CEO and Managing Director, CRIF High Mark, spoke on "The Credit Bureau Ecosystem in India" on February 14, 2020.

Ms. Kalpana Pandey, CEO & MD, CRIF High Mark, speaking on "The Credit Bureau Ecosystem in India"

6

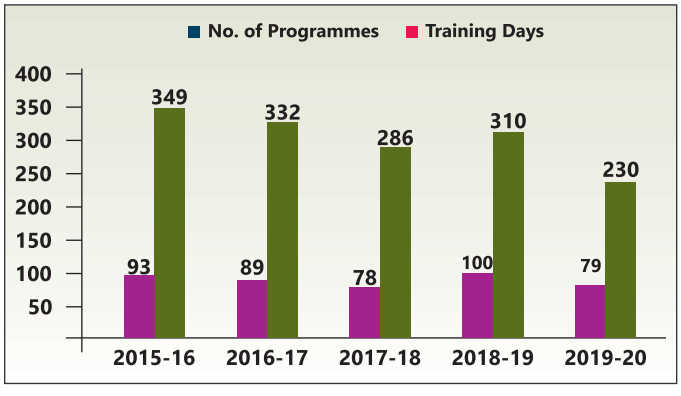
EXECUTIVE EDUCATION AND DEVELOPMENT

Background

THE Institute's executive development programmes focus on equipping and preparing the top and middle-level managements of Banks and Financial Institutions with the latest in Banking Technology. The endeavour of the Institute through these training programmes is to find and address the skillset gaps and requirements in the ever evolving technology scenario.

Programmes

During the period July 2019 – June 2020, the Institute conducted 79 programmes. The tables below encapsulate the number of programmes and number of training days held during the last five years.



The highlights of the programmes offered by the Institute during the year are as under:

Programmes in the Top Management Channel

- 10th Bank Executive Programme @ NIBM, Pune by IDRBT, IIBF & NIBM, July 15-19, 2019
- 11th Bank Executive Programme @ IIBF, Mumbai by IDRBT, IIBF & NIBM, November 04-08, 2019
- RBI Payment and Settlement Systems in India: Vision 2019-2021, November 18-19, 2019
- "HR Related Issues in Banks' BCP during Pandemics" for Board Members, May 15, 2020
- "Cyber Security: During Pandemic and Beyond" for Board Members, June 12, 2020

Customised Programmes

- Data Analytics for SEBI – August 05-10, 2019
- Big Data Analytics for NABARD – August 19-21, 2019
- Emerging Banking Technologies for National Bank Staff College – January 27-31, 2020
- Cyber Security for National Bank Staff College – February 10-12, 2020
- Cyber Security for Reserve Bank of India, New Delhi – February 25, 2020

New Programmes

- Software Defined Networks
- Dockerization
- DevOps
- Machine Learning, Deep Learning
- 5G and Mobile Financial Services
- Banking Application – Life Cycle Management
- Tokenisation
- Red Team and Blue Team Exercise
- API Security and Governance
- Early Warning Systems with Analytics
- Business through Analytics
- Data Science in Banking and Finance

- Artificial Intelligence Based Technologies for Smart Banking
- Governance, Risk & Compliance
- IT Project Management
- Security in Cloud Computing

General Programmes

- Cyber Defense for Banks
- Data Centre Management
- API Development
- Website Security
- IT Project Management
- Technologies for Financial Inclusion
- Security Operations Centre
- Information Systems Control and Audit
- Big Data Analytics with Hadoop and Spark
- Red Team and Blue Team Exercise
- IT Vendor Management
- Network Security
- Secure Coding Practices
- Data Science in Banking and Finance
- Payment Systems – Current Trends and New Initiatives

Shr Avinash W Kadam, Cyber Security Mentor, delivering a talk in a top management programme held at IDRBT

e-Programmes

In the wake of Coronavirus outbreak and the resultant travel restrictions, the Institute on a priority basis worked on and introduced an e-Learning channel for training programmes in May 2020, so that the Indian Banking and Financial Sector remains abreast of the latest in technology, especially given the increased dependency on technology during the pandemic.

During the period May 2020 – June 2020, the Institute conducted 12 e-programmes and trained around 260 participants. During this period, the Institute also conducted a customized e-Programme on Secure Coding Practices for Canara Bank.

These e-Programmes provided the required learning inputs through online teaching, reading material, videos, webinars, assignments, quizzes, online interactions and clarifications. The details of the other e-programmes offered during the period is as under:

- IT Project Management
- Re-envisioning Digital Banking Systems
- Recent Cyber Crimes and Defences
- Continuous Security Validation
- Technologies for Customer Life Cycle Management
- RBI Guidelines on Cyber Security
- Trends in Mobile Payments and Social Media Banking
- Fundamentals of Open-Source Technologies
- Secure Coding Practices for Canara Bank
- Introduction to Fraud Analytics
- Introduction to Technologies for Doorstep Banking
- Fundamentals of Wi-Fi Security

Certification Programmes in IT & Cyber Security

With a view to enhance the management's awareness in banks, of the IT and Cyber Security issues, the Institute has been offering Certification Programmes in IT & Cyber Security for the three specific target groups, segregated based on their roles in the banks, as under:

- Two-day Certification Programmes in IT & Cyber Security for Board Members
- Two-day Certification Programmes in IT & Cyber Security for Senior Management
- Five-day Certification Programmes in IT & Cyber Security for CXOs

During the year, the Institute conducted seven certification programmes for Board Members, 15 certification programmes for Senior Management and three certification programmes for CXOs. Overall, 688 participants from across public, private and foreign banks were trained as part of the cyber security certification programmes.

The Institute also organised a customised Certification Programme in IT and Cyber Security for Board and Senior Management of Kotak Mahindra Bank.

A Group of Senior Bankers get together for a certificate programme held at IDRBT

7

COLLABORATIVE INITIATIVES

AN important initiative ideated by the Institute to enable constant deliberation on common technology issues between senior managements of banks and the Institute are various Forums. These forums focus on different aspects of Banking Technology and presently, the Institute has the following Forums:

- Chief Information Officers (CIO) Forum
- Chief Information Security Officers (CISO) Forum
- Chief Analytics Officers (CAO) Forum
- FinTech Forum

This chapter presents the activities of these forums during the year:

CIO Forum

The Eighth Meeting of the Indian Banks' CIO forum, held on July 19, 2019, mainly focused on Payment Systems and Fintech Collaboration. In the area of Payment Systems, the following points were deliberated: while the banks are mandated to register an FIR in case of a forged currency note, there is no suitable parallel in the digital system - a single platform for the nation, the need for Govt., insurance and statutory payments to be excluded from the transaction count of BSBD accounts, and when many payment systems are co-existing, there may also be some sunset mechanism for payment systems whose usage is on the wane.

On Fintech Collaboration, the discussions centered on the need for digital identity with privacy data protection; Voice-based banking / Alexa and similar integration; USSD improvements – usability and other use cases; Check image analysis and context mining, etc. A Working Group to identify API standards and Use Cases was constituted so that the FinTechs can collaborate with banks more easily. The importance of dispute resolution and governance in API Management was also deliberated upon.

The last session – the Open Forum – was devoted to discussing current issues of concern for CIOs, like Windows migration, C-KYC, Scope of Unplanned DR Drills, Escrow arrangements for critical applications and so on. Fruitful discussions took place on these and participants shared their tips and inputs for the benefit of the community.

February 17 - 18, 2020

The Ninth Meeting of the Indian Banks' CIO forum was held on February 17–18, 2020. The meeting deliberated on preparing the Banking and Financial Sector for 5G and ways and means to leverage 5G for improving productivity, reach and profits, issues related to HR Challenges and Capacity Building in various domains of technology, and strategies to enable seamless collaboration between Banks and Fintechs.

CIO Forum meet in progress at IDRBT in February 2020

Thereafter, the Institute demonstrated a Blockchain Platform for banks and the improved Certifying Authority Services. The CIOs then shared their current and upcoming technology

concerns. Various strategies to address these concerns were deliberated. 26 Chief Information Officers of various banks participated.

June 12, 2020

The tenth meeting of the CIO Forum was held on June 12, 2020 on the theme of "Impact and innovations during the pandemic".

Shri. H. Krishnamurthy spotlighted the challenges in Work from Home and suggested approaches to ensure focus on minimizing loss of productivity. The challenges of bring-your-own-devices / internet (BYOD, BYOI), mitigation approaches for protection; the need to update the IT Strategy and Information Security Strategy, along with the integration of PIM/SIEM with the remote access applications were discussed. Shri. Soham Banerjee, Cisco, dwelt on the need of application perception management, especially how the multichannel approach of engaging customers can delight them.

These sessions were followed by an Open Forum on "current concerns and challenges in IT response to the COVID pandemic", moderated by Shri. D. A. Tambe, DMD & CIO, SBI; Shri. N. K. Subramanyam, CIO, CITI Bank; and Ms. Asmita Gada, Head, IT Governance, HDFC Bank. 15 CIOs of various banks participated.

CISO Forum

The Institute's CISO Forum is serving as an effective platform for the CISOs of banks to discuss and resolve information security related issues. The CISO Forum meet, held once in every quarter, was held on August 19 – 20, 2019 at IDRBT, on November 21 -22, 2019 at Oriental Bank of Commerce, Gurgaon, on February 24-25, 2020 at IDRBT and via the online mode on May 29, 2020.

August 19 – 20, 2019

Shri G Narendranath, Joint Secretary, National Security Council, started the proceedings by spotlighting a wide range of cyber threats landscape for Banking Sector, especially from Phishing/Vishing attacks.

Shri G. Narendranath, Joint Secretary, National Security Council, speaking on Cyber Threats

Strategies for enhancing Security Governance within a bank, essential Information Security measures that all banks should adopt, Tools that can be deployed by banks for cyber security management; Security Search Engines, Malwares, upgrading from SOC 2.0 to SOC 3.0, Mobile App Security, Extended Security Solutions using Biometrics backed by AI and Behaviour Analytics, NIST Cyber Security Framework, Application and Data Protection were the key issues discussed.

The findings from the 18th Cyber Drill conducted on August 6, 2019 were also deliberated upon. 54 CISOs participated.

November 21 – 22, 2019

The Oriental Bank of Commerce hosted the meeting of the CISO Forum held on November 21-22, 2019. Shri Mukesh Kumar Jain, MD & CEO,

Oriental Bank of Commerce and Dr. A. S. Ramasastri, Director, IDRBT inaugurated the meet.

Shri Mukesh Kumar Jain, MD & CEO, Oriental Bank of Commerce, inaugurating the CISO Forum Meet with Dr. A. S. Ramasastri, Director, IDRBT

The meet deliberated on identification of critical information infrastructure, cyber security initiatives/circulars which are taken/issued by various Government/regulatory bodies, implementing Network Access Control (NAC) in banks, ensuring cyber security in the event of merger between multiple banks, current cyber threat landscape, cyber insurance and resolving cyber security problems through machine learning techniques. 60 CISOs participated.

February 24-25, 2020

Shri S. Ganesh Kumar, Executive Director, RBI, set the tone for the meeting by focusing attention on 'Safety and Security' and 'Fear of Unknowns' for CISOs in the context of digitisation of banks, information security and data localisation aspects related to payment systems.

TLS implementation for e-mail security, PCIDSS implementation challenges & best practices, four-layer security approach consisting of End Point Analysis, Network Analysis, Security Log Analysis, Database Monitoring, Device Visibility to secure

Shri S. Ganesh Kumar, ED, RBI, addressing the CISOs

networks, Runtime Full Stack Application Protection, Deception Platform, etc., were the key issues discussed.

The findings from the 20th Cyber Drill conducted during the month were also deliberated upon. 50 CISOs participated

May 29, 2020

The Director, IDRBT, started off the proceedings by highlighting technology as well as business strategy challenges while working from home and stressed on creating a dossier for similar situations. Shri A. S. Rajeev, MD & CEO, Bank of Maharashtra and Shri Hemant Tamta, Executive Director, dwelt upon about the importance of infrastructure facilities, its development and aligning it with business strategies.

New attacks like Advanced Java RAT, Minebridge Backdoor attack, New developments in Crypto-Ransomware like Maze and RagnerLocker, Vulnerabilities in remote desktop access, Practical problems in VPN connection and requirements for Work from Home, MAC binding and OTP-based connectivity while providing VPN connections, Current and desired state of intel-analysis, enrichment and sharing, Factors shaping for New

Digital Risk Environment, Zero Trust Security Controls with case studies, etc., were also deliberated upon.

The report of the 21st Cyber Security Drill, which was conducted on May 20, 2020, was presented. The IDFC First Bank shared their experiences in detecting attacks in the drill. 62 CISOs participated.

CAO Forum

The fifth meeting of the Chief Analytics Officers Forum was held at HDFC Bank, Mumbai, on December 05, 2019.

The meet first took up the theme-based panel discussion on Trends in Fraud Detection in banks by Predictive Analytics (subsuming AI/ML), which was moderated by Shri Manish Agarwal, Fraud Prevention Head, HDFC Bank. This was followed by a presentation on Analytics initiatives of HDFC Bank and session on Data Privacy and Security.

Thereafter, there were two Panel Discussions on the following topics: Fintechs as strategic partners for Banks: Challenges and Opportunity, which was moderated by Prof. V. Ravi, Coordinator, CAO Forum, IDRBT; and Growth of new age technologies in Financial Services such as Hadoop, Dialer Platforms and Voice Analytics, OCR, Cloud based services, IoT; which was moderated by Shri Ashish Abraham, Group Head, Analytics, HDFC Bank. 18 CAO's participated.

CAO Forum Meet in progress at HDFC Bank, Mumbai on December 05, 2019

FinTech Forum

August 05, 2019

The Fourth meeting of the Fintech Forum was held on August 05, 2019. In the first session, four FinTechs demonstrated their products. In parallel, a platform demonstration session by Microsoft (Azure) and CDAC (Proof-of-existence) was held. In the second session, fourteen FinTechs presented their technologies that could solve various problems of banking domain.

A Snapshot from the FinTech Forum held in August 2019 at IDRBT

A meeting of the FinTech Forum Advisory Committee was also held on the occasion, wherein it was decided to form four working groups focussing on web-portal, test-environment process, use-case shortlisting and environment enablers. It was also felt that it would be useful to classify the Fintechs as per their capabilities and focus areas. 35 Fintechs and 14 banks participated.

November 29, 2019

A meeting of FinTechs on the theme of Financial Inclusion was held on November 29, 2019. The Bharat Inclusion initiative, how FinTech solutions can benefit from narrowband IoT, and best practices and market dynamics of business correspondent model were discussed. Four FinTechs showcased their products / solutions focused on improving Financial Inclusion.

Thereafter, three use cases on the following were discussed:1) Next-generation platform to improve trust and expand coverage in remote areas; 2) Voice-enabled banking and financial services in local languages; and 3) Banking on feature phones – simplifying USSD or usage of alternate means. 16 FinTechs, 8 Banks and NPCI, NABARD, TIHCL, and IFTAS participated.

Further, as part of its Fintech engagement initiative, the IDRBT Bank Fintech eXchange (IBFX) now enables two-way communication between banks and FinTechs. It takes problem statements from banks and mentors FinTechs to solve these problems. Hackathons, competitions and workshops on such thematic areas are planned.

The IBFX tests the final solution with one or more banks as anchors. IBFX also reviews and mentors the ongoing FinTech engagements at various banks and enables the sharing of best practices in this realm. Further, the coordination team of IBFX filters the registered FinTechs and showcases their innovations at multiple forums (Fintech forum, CIO forum, various labs, and experience zones at IDRBT, etc.) so that the banking sector becomes aware and exploits the innovations.

8

RESEARCH PUBLICATIONS

DURING the year, the Institute published in various National and International Journals/Conferences. The research publications of the Institute during the year are as under:

Papers Published in Journals

Dr. V. N. Sastry

- Manojkumar Vivekanandan, V. N. Sastry & U. Srinivasulu Reddy: Efficient User Authentication Protocol for Distributed Multimedia Mobile Cloud Environment. Journal of Ambient Intelligence and Humanized Computing, September 12, 2019, Springer
- Mallikarjun Reddy Dorsala, V. N. Sastry, Sudhakar Chapram: Fair Payments for Verifiable Cloud Services using Smart Contracts. Computers and Security, January 2020, Elsevier

Dr. M. V. N. K. Prasad

- Johnpaul C.I, Munaga V. N. K. Prasad, S. Nickolas and G.R. Gangadharan: Trendlets: A Novel Probabilistic Representational Structures for Clustering the Time Series Data. Expert Systems with Applications, December 02, 2019
- Morampudi Mahesh Kumar, Munaga VNK Prasad, and U. S. N. Raju, "Privacy-preserving iris authentication using fully homomorphic encryption." Multimedia Tools and Applications (Springer), pp. 1-23, March 18, 2020. DOI: https://doi.org/10.1007/s11042-020-08680-5
- Morampudi Mahesh Kumar, Sowmya Veldandi, Munaga VNK Prasad, and U. S. N. Raju. "Multi-instance iris remote authentication using private multi-class perceptron on malicious cloud server." Applied Intelligence (Springer), March 28, 2020. DOI: https://doi.org/10.1007/s10489-020-01681-9
- Morampudi Mahesh Kumar, Munaga VNK Prasad, and U. S. N. Raju, "BMIAE: Blockchain-based Multiinstance Iris Authentication using Additive ElGamal Homomorphic Encryption." IET Biometrics, 9(4):165- 177, May 20, 2020. DOI: https://doi.org/10.1049/iet-bmt.2019.0169
- S Sridhar Raj, Munaga V N K Prasad, Ramadoss Balakrishnan, "Deep manifold clustering based optimal pseudo pose representation (DMC-OPPR) for unsupervised person re-identification" Image and Vision Computing, vol.101, pp.103956/1-16, 31 May, 2020

Dr. Rajarshi Pal

- Dansena, P., Pal, R., Bag, S.: Quantitative assessment of capabilities of color models for pen ink discrimination in hand-written documents. IET Image Processing, 14(8), pages 1594-1604. January 29, 2020 https://digital-library.theiet.org/content/journals/10.1049/iet-ipr.2018.6616

Dr. P. Syam Kumar

- Umasankararao Varri, Syam Kumar Pasupuleti, K. V. Kadambari: A Scoping Review of Searchable Encryption Schemes in Cloud Computing: Taxonomy, Methods and Recent Developments. Journal of Super Computing, November 22, 2019.

- Premkamal, P.K., S.K. Pasupuleti, and P.J.A. Alphonse (2020). Dynamic traceable CP-ABE with revocation for outsourced big data in cloud storage. International Journal Communication Systems (IJCS). Wiley. https://doi.org/10.1002/dac.4351 February 20, 2020
- Premkamal, P.K., Pasupuleti, S.K. & Alphonse, and P.J.A.: Enhanced attribute based access control with secure deduplication for big data storage in cloud. Peer-to-Peer Networking and Applications, Springer https://doi.org/10.1007/s12083-020-00940-3 (Accepted, May, 2020)

Dr. Abhishek Thakur

- Thakur A: SORT: A System for Adaptive Transmission of Video Over Delay Tolerant Networks. International Journal of Wireless Networks and Broadband Technologies (IJWNBT). 9(2),22- 49 (2020).

Dr. Mridula Verma

- Verma, M., Shukla, K.K.: Convergence analysis of accelerated proximal extra-gradient method with applications. Neurocomputing, 388, 288-300 May 2020, Elsevier

Dr. Susmita Mandal

- Mandal, S., Mohanty, S. & Majhi, B. CL-AGKA: Certificateless authenticated group key agreement protocol for mobile networks. Wireless Networks, 26, 3011–3031 January 16, 2020, Springer https://link.springer.com/article/10.1007/s11276-020-02252-z

Dr. Dipanjan Roy

- Roy, D.: Design Process of Zero Area and Minimal Delay Overhead based IP Watermarking during Scheduling for High-level Synthesis Tools. IEEE VLSI Circuit and System Letters. 6(2), 10-12 (2020)

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Dr. V. N. Sastry

- Manimaran Sivasamy, Sastry, V. N & Gopalan N. P. "VRCAuth: Continuous Authentication of Users in Virtual Reality Environment using Head-Movement". In 2020 IEEE 5th International Conference on Communication and Electronics Systems (ICCES 2020), June 10-12, 2020

Dr. V. Ravi

- Krishna, G. J., Ravi, V.: Keystroke based User Authentication using Modified Differential Evolution. In IEEE TENCON, Kochi, Kerala, India (October, 2019)
- Krishna, G. J., Ravi, V., Reddy, B.V., Zaheeruddin, M., Jaiswal, H., Teja, P.S.R, Gavval, R. Sentiment Classification of Indian Banks' Customer Complaints. In IEEE TENCON, Kochi, Kerala, India (October, 2019)

- Krishna, G. J., Jaiswal, H., Teja, P.S.R, Ravi, V.: Keystroke based User Identification with XGBoost. In IEEE TENCON, Kochi, Kerala, India (October, 2019)
- Krishna, G. J., Ravi, V.: Anomaly Detection using Modified Differential Evolution: An Application to Banking and Insurance. In Proceedings of 11th International Conference on Soft Computing and Pattern Recognition (SoCPaR), Hyderabad, India. Springer (December, 2019)
- Gangwar, A.K., Ravi, V.: Generative Adversarial Network for Oversampling Data in Credit Card Fraud Detection. In proceedings of 15th International Conference on Information Systems Security (ICISS), Hyderabad, India. Springer (December, 2019)
- Reddy, B.V., Krishna, G.J., Ravi, V., Dasgupta, D.: Machine Learning and Feature Selection based Ransomware Detection using Hexacodes. In Proceedings of 8th International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA), NITK, Surathkal, India. Springer (January, 2020)
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9

TEAM IDRBT

DIRECTOR

Dr. A. S. Ramasastri

FACULTY

Dr. V. N. Sastry
Professor

Areas: Mobile Payments; Mobile Governance; Security Models; Financial Engineering

Dr. V. Ravi
Professor

Areas: Data Warehouse & Data Mining, Big Data & Analytics, Machine Learning, Customer Relationship Management

Dr. B. M. Mehtre
Professor

Areas: Cyber Security, Digital Forensics, Biometrics

Dr. M. V. N. K. Prasad
Associate Professor

Areas: Biometrics, Payment System Technologies, Financial Inclusion

Dr. N. P. Dhavale
Associate Professor

Areas: Information Security Engineering, Internet of Things, Mobile Banking

Dr. V. Radha
Associate Professor

Areas: Virtualization & Cloud Computing, Network Security, Computer Applications

Dr. Rajarshi Pal
Assistant Professor

Areas: Social Media, Cyber Fraud Prevention, Image Processing and Computer Vision

Dr. N. V. Narendra Kumar
Assistant Professor

Areas: Design, Modelling, Security Analysis of Systems

Dr. P. Syam Kumar
Assistant Professor

Areas: Cloud Computing, Parallel & Distributed Computing, Cryptography, Network Security

Dr. Abhishek K Thakur
Assistant Professor

Areas: Computer Networks, Multimedia Systems, Mobile Applications

Dr. Mridula Verma
Assistant Professor

Areas: Machine Learning Algorithms, Data Mining, Data Science

Dr. Susmita Mandal
Assistant Professor

Areas: Non-Interactive Key Exchange, Financial Cryptography, Authentication

Dr. Dipanjan Roy
Assistant Professor

Areas: Hardware Security, Reusable Intellectual Property Core Protection, High-Level Synthesis in CAD-VLSI

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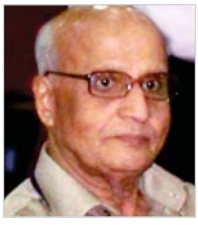

Dr. B. L. Deekshatulu
Area: Faculty Mentoring

Dr. M. S. Sriram
Area: Financial Inclusion

Prof. Venu Govindaraju
Areas: Cyber Security, Information Assurance, Biometrics

Dr. D. K. Subramanian
Areas: Banking Technology, Technology Services

Dr. Santanu Paul
Areas: Knowledge Management, IT Governance

Shri Avinash W Kadam
Areas: Information Security, IS Audit, IT Management

Dr. Rajkumar Buyya
Area: Cloud Computing

STAFF

Shri P. Parthasarathi
Chief Technology Officer

Shri Vijay Belurgikar
Deputy General Manager, Accounts & Estate

Dr. S. Rashmi Dev
Asst. General Manager, HR & Publications

Shri E. Ravinder
Asst. General Manager, Systems & CA

Smt R. S. Sirisha
Manager, Administration

Shri K. V. R. Murthy
Systems Officer

Shri E. Srihari
Project Officer

STAFF

Smt Varsha Srivastava
Administrative Officer

Shri P. Balasubramanyam
Administrative Officer

Shri K. Srinivas
Administrative Executive

Shri Srinivas
Administrative Executive

Shri Prakash Dhavale
Library Associate

Shri Anurag Nanda
Administrative Executive

Shri Ganji RL Varaprasad
Administrative Associate

Shri Jino Thomas
Administrative Executive

Shri K. Dharmender
Administrative Assistant

Shri Dokku Chaitanya
Administrative Executive

Shri G. R. Narsinga Rao
Administrative Assistant

ANNEXES

Explore, Enable, Excel

Annex - A

Ph.D. Scholars

S. No.	Name of Research Fellow	Area	Supervisor
1	V. Manoj Kumar	Quality of Service and Security aspects in Mobile Governance	Dr. V. N. Sastry
2	S Manimaran	Fuzzy Control of Intrusions in Mobile & IoT Devices	Dr. V. N. Sastry
3	Dorsala Mallikarjun Reddy	Securing Mobile Financial Services using Blockchain Technology	Dr. V. N. Sastry
4	Singampalli Tejaswi	Recommendar Systems	Dr. V. N. Sastry
5	S K Kamaruddin	Big Data Analytics and Applications	Dr. V. Ravi
6	Narottam Das Patel	Cloud Computing	Dr. B. M. Mehtre
7	Malvika Singh	Behavioral Research in Cyber Security	Dr. B. M. Mehtre
8	R. Chandra Shekhar	Cloud Security and Analytics	Dr. M. V. N. K. Prasad
9	John Paul C. I	Machine Learning in Energy Informatics	Dr. M. V. N. K. Prasad
10	Mukku Nisanth Kartheek	Biometrics	Dr. M. V. N. K. Prasad
11	Morampudi Mahesh Kumar	Reliable and Privacy-preserving Iris Remote Authentication Techniques	Dr. M. V. N. K. Prasad
12	Sridhar Raj S	Deep Learning in Biometrics	Dr. M. V. N. K. Prasad
13	Srinadh Swamy Majeti	Metric for Mobile Security and Application Testing	Dr. N. P. Dhavale
14	P. V. Shalini	Network Security in software defined networks	Dr. V. Radha
15	Amarajyothi Aramanda	Information Retrieval Systems	Dr. V. Radha
16	Sanda Pranitha	Cloud Forensics	Dr. V. Radha
17	K. Suresh	Bio-Crypto Systems	Dr. Rajarshi Pal
18	Shadab Ahmad	Biometrics	Dr. Rajarshi Pal
19	M. Sabhapathy	Machine Learning for Reversible Data Hiding	Dr. Rajarshi Pal

S. No.	Name of Research Fellow	Area	Supervisor/s
20	P Avinash	Big Data Analytics	Dr. N. V. Narendra Kumar
21	Ravi Kanth Kotha	Privacy-preserving Data Analysis	Dr. N. V. Narendra Kumar
22	Sukanya Deka	Computational Social Choice	Dr. N. V. Narendra Kumar
23	Nunna Satya Krishna	Machine Learning	Dr. N. V. Narendra Kumar
24	G. Jaya Rao	Cloud Computing for Banking	Dr. P. Syam Kumar
25	V Uma Sankara Rao	Privacy Preserving of Data in Cloud Computing	Dr. P. Syam Kumar
26	Medikonda Asha Kiran	Security and Privacy in Cloud assisted IoT	Dr. P. Syam Kumar
27	Neha Joshi	Cross-Layer and Cross-Network Optimization for Live Video Streaming in 5G Networks	Dr. Abhishek Kumar

Annex - B

Participants of the Ninth IDRBT Doctoral Colloquium

S. No.	Name of the Scholar	Name of the Institute	Topic
1	Daksh Thapar	Indian Institute of Technology, Mandi	Multi-view and cross angle gait based behavioural biometric recognition system using Deep Learning
2	Ankita Mandal	Indian Statistical Institute, Kolkata	Scalable Regularized Canonical Correlation Analysis for Multimodal Omics Data
3	Chandra Sekhar	Indian Institute of Information Technology, Sri City	An Interpretable Indic Optical Character Recognition through Domain Adaptation and Discriminative Localization Based Techniques
4	Javed Imran	Indian Institute of Technology, Roorkee	Deep Residual Infrared Action Recognition by Integrating Local and Global Spatio-Temporal Cues
5	Sanchayan Santra	Indian Statistical Institute, Kolkata	Image Dehazing by Learning to Compare Patches

S. No.	Name of the Scholar	Name of the Institute	Topic
6	Gunjan Gautam	Indian Institute of Technology (Indian School of Mines), Dhanbad	Intelligent Recognition of Twins using Deep Ocular Features
7	Aakarsh Malhotra	Indraprastha Institute of Information Technology, Delhi	Finger-selfies: A Secure and Economical Method for User Authentication
8	Ravi Uyyala	IDRBT, Hyderabad	Reversible Data Hiding Using Reference Pixel Based Prediction
9	Hridoy Sankar Dutta	Indraprastha Institute of Information Technology, Delhi	CoReRank: Ranking to Detect Users Involved in Blackmarket-based Collusive Retweeting Activities
10	Chandana Roy	Indian Institute of Information, Kharagpur	Safe-aaS: Decision Virtualization for Effecting Safety-as-a-Service
11	Sanjay Moulik	Indian Institute of Technology, Guwahati	HEALERS: A Heterogeneous Energy-Aware Low-overhead Real-time Scheduler

Annex - C

PGDBT Placements 2019-20

S. No.	Name of Student	Placed with
1	A. Alekya	Kotak Mahindra Bank
2	Agrawal Vishwesh Deepak	The Karur Vysya Bank Ltd.
3	Buridi Theja Sainadh	The Karur Vysya Bank Ltd.
4	Challagali Satya Suma Sri	The Karur Vysya Bank Ltd.
5	Chigurupati Yagna Deepika	The Karur Vysya Bank Ltd.
6	Chintapalli Srivatsav	The Karur Vysya Bank Ltd.
7	Gogada Revanth	Kotak Mahindra Bank Ltd.
8	Goriparthi Sandeep	The Federal Bank Ltd.
9	Gutti Sushmitha	City Union Bank Ltd.
10	K M Priya Pandey	The Karur Vysya Bank Ltd.
11	Kollipara Naveen Murthy	The Karur Vysya Bank Ltd.

S. No.	Name of Student	Placed with
12	Nagipogu Praveen Kumar	City Union Bank Ltd.
13	Papishetty Kalki Prasad	The Karur Vysya Bank Ltd.
14	Perakam Sashidhar	The Karur Vysya Bank Ltd.
15	Pothukuchi Tarun	The Karur Vysya Bank Ltd.
16	Reshma Mutha	The Karur Vysya Bank Ltd.
17	Thappeta Lakshmi Prasanna	The Karur Vysya Bank Ltd.

Annex - D

M. Tech. Projects 2019-20

S. No.	Name of Student	Guide	Name of the Project
1	Sanga Prathamesh Prakash	Prof. V.N. Sastry	APIs for social media based mobile financial services
2	Ritik Raj	Prof. V.N. Sastry	5G based smart ATM Services
3	Alok Kumar Verma	Prof. V.N. Sastry	Forecasting of Financial flows in networks
4	Vishnu Vardhan Reddy	Prof. V. Ravi	Deep Neural Networks for financial applications
5	Basit Ali	Prof. V. Ravi	Deep learning and big data analytics application to finance and science
6	Vangala Sarveswara Rao	Prof. V. Ravi	New deep learning architectures, evolutionary computing in financial applications
7	G. Hareesh	Prof. B.M. Mehtre	Anti-forensics techniques for protecting privacy
8	Chandra Shekar TR	Dr. N.P. Dhavale	Design and development of mobile app and business anlaytics from the data in the app for bank officers in CUG
9	S. A. Nazreen	Dr. Rajarshi Pal	Reversible Data Hiding in Colour Images
10	Avasarala Jagadeesh	Dr. Rajarshi Pal	Audio Visual Spoof detection
11	Dandi Sai Sreehari Prasad	Dr. Rajarshi Pal	Gaze based graphical password

S. No.	Name of Student	Guide	Name of the Project
12	Rakesh Prasad	Dr. N. V. Narendra Kumar	Blockchain Technology - Application Layer
13	Pranshu Mishra	Dr. N.V. Narendra Kumar	Blockchain Technology - Platform Layer
14	Rakesh Kumar	Dr. P. Syam Kumar	Trusted Security Assessment model for JaaS Clouds
15	Naroju Vamshidhar	Dr. P. Syam Kumar	Dynamic energy-efficient virtual machine consolidation in cloud data centers
16	Adouthu Vamshi Naik	Dr. P. Syam Kumar	Secure data aggregation scheme for fog computing based IoT
17	Sushil Kumar	Dr. Abhishek K. Thakur	Security and network management in 5G deployments
18	Hem Chandra Joshi	Dr. Abhishek K. Thakur	Highlight creation and event detection with massive video feeds
19	Mahipal Singh	Dr. Mridula Verma	Application of large scale machine learning in BFSI
20	Leichombam Somorjit Singh	Dr. Mridula Verma	Applications of deep learning framework in BFSI

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Castle Hills, Road No.1, Masab Tank, Hyderabad - 500057, India.
EPABX: +91 40 2329 4999, Fax: +91 40 2353 5157
Web: www.idrbt.ac.in, Email: publisher@idrbt.ac.in