Digital Eavesdropper: Acoustic Speech Characteristics as Markers of Exacerbations in COPD Patients

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Abstract—Research suggests that speech deterioration indicates an exacerbation in patients with chronic obstructive pulmonary disease (COPD). This study provides a comparison of read speech of 9 stable COPD patients and 5 healthy controls (I) and 9 stable COPD patients and 9 COPD patients in exacerbation (II). Results showed a significant effect of condition on the number of (non-linguistic) in- and exhalations per syllable (I, II) and the ratio of voiced and silence intervals (II). Also, sustained vowels by 10 COPD patients in exacerbation were compared with 10 vowels in stable condition (III). Results showed an effect of condition on duration, shimmer, harmonics-to-noise ratio (HNR) and voice breaks. It was concluded that HNR, vowel duration and the number of (non-linguistic) in- and exhalations per syllable show potential for remote monitoring. Further research is needed to examine the validity of the results for natural speech and larger sample sizes.

Keywords—COPD, lung exacerbations, pulmonary disease

I. INTRODUCTION

A. Speech and Speech Disorders

Each human language consists of a set of vowels and consonants which are combined to form words. During the speech production process, thoughts are converted into spoken utterances to convey a message. The appropriate words and their meanings are selected in the mental lexicon [1]. This pre-verbal message is then grammatically encoded, during which a syntactic representation of the utterance is built. The sounds are yet to be specified, but the abstract word symbols are assigned to their grammatical function before they are structured in a syntactic frame to determine the order [2]. Subsequently, the message is phonologically encoded. During this stage, a phonetic or articulatory plan is retrieved for each individual lemma and the utterance as a whole. Finally, the speaker produces the utterance according to the phonetic plan [3].

(COPD) by investigating which aspects of speech differ between COPD patients and healthy speakers and which aspects differ between COPD patients in exacerbation and stable COPD patients.

B. Chronic Obstructive Pulmonary Disease

1) Background: COPD is an umbrella term used to describe progressive lung diseases characterized by airflow limitation. According to the guidelines provided by the Global Initiative for Chronic Obstructive Lung Disease [6, p. 2], the official definition of COPD is "a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases."

2) Prevalence: The prevalence of COPD worldwide is estimated at roughly 12%, but the percentage differs greatly between different subgroups [7]. Most COPD patients are suffering from stage II COPD (70%), while stage I, III and IV make up respectively 16%, 11% and 3% of the COPD population. The four greatest predictors of COPD are years and intensity of smoking, age, sex and BMI. Most patients suffering from COPD are smokers with a low BMI, over 50 years old and male [7].

Taking into account the three million annual deaths globally, COPD is currently the fourth leading cause of death in high-income countries and it is expected to be the third leading cause in 2020 due to a higher life expectancy and increasing air pollution [6, 8, 9]. However, the lung disease has been overlooked and neglected for a long time by both the public and the pharmaceutical industry. This neglect might be caused in part by the assumption that COPD is a self-inflicted health condition caused by smoking. Although smoking is the leading cause of COPD in high-income countries, over 15%

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5G Wireless Network Security and Privacy DongFeng Fang,Yi Qian,Rose Qingyang Hu,2023-11-02 5G WIRELESS NETWORK An expert presentation of 5G security privacy and network performance In 5G Wireless Network Security and Privacy a team of veteran engineers delivers a robust and accessible discussion of 5G security solutions including physical layer security authentication and mobility management In the book the authors expertly cover the requirements of 5G wireless network security and privacy with explorations of existing solutions and vulnerabilities from security architecture and mechanism perspectives Readers will learn how to enhance the security and network performance of 5G wireless networks in contexts like vehicle to vehicle and vehicle to infrastructure communications industrial automation health services smart cities and smart homes They will develop a comprehensive understanding of 5G wireless network security as they move through the book s 11 insightful chapters developing in depth knowledge on the current state of 5G security and coming developments in the field Readers will also find A thorough introduction to legacy cellular network security including network performance development from 1G to 4G In depth treatments of 5G network security including the motivation and objectives of 5G wireless network security Comprehensive explorations of wireless security solutions including cryptographic approaches and physical layer security Fulsome discussions of the security architecture of cellular networks including 3G and 4G security Perfect for researchers and professionals working in the field of cybersecurity and 5G wireless networks 5G Wireless Network Security and Privacy will also earn a place in the libraries of engineers computer scientists and graduate students studying 5G network security and privacy *Next Generation Wireless Network Security and Privacy* Lakhtaria, Kamaljit I.,2015-10-13 As information resources migrate to the Cloud and to local and global networks protecting sensitive data becomes ever more important In the modern globally interconnected world security and privacy are ubiquitous concerns Next Generation Wireless Network Security and Privacy addresses real world problems affecting the security of information communications in modern networks With a focus on recent developments and solutions as well as common weaknesses and threats this book benefits academicians advanced level students researchers computer scientists and software development specialists This cutting edge reference work features chapters on topics including UMTS security procedural and architectural solutions common security issues and modern cryptographic algorithms among others Recent Trends in Blockchain for Information Systems Security and Privacy Amit Kumar Tyagi,Ajith Abraham,2021-11-23 Blockchain technology is an emerging distributed decentralized architecture and computing paradigm which has accelerated the development and application of cloud fog and edge computing artificial intelligence cyber physical systems social networking crowdsourcing and crowdsensing 5g trust management and finance and other many useful sectors Nowadays the primary blockchain technology uses are in information systems to keep information secure and private However many threats and vulnerabilities are facing blockchain in the past decade such 51% attacks double spending attacks etc The popularity and rapid development

of blockchain brings many technical and regulatory challenges for research and academic communities The main goal of this book is to encourage both researchers and practitioners of Blockchain technology to share and exchange their experiences and recent studies between academia and industry The reader will be provided with the most up to date knowledge of blockchain in mainstream areas of security and privacy in the decentralized domain which is timely and essential this is due to the fact that the distributed and p2p applications are increasing day by day and the attackers adopt new mechanisms to threaten the security and privacy of the users in those environments This book provides a detailed explanation of security and privacy with respect to blockchain for information systems and will be an essential resource for students researchers and scientists studying blockchain uses in information systems and those wanting to explore the current state of play

Security, Privacy and Anonymity in Computation, Communication and Storage Guojun Wang,Indrakshi Ray,Jose M. Alcaraz Calero,Sabu M. Thampi,2016-11-09 This volume constitutes the refereed proceedings of six workshops held at the 9th International Conference on Security Privacy and Anonymity in Computation Communication and Storage SpaCCS 2016 held in Zhangjiajie China in November 2016 the 7th International Workshop on Trust Security and Privacy for Big Data TrustData 2016 the 6th International Symposium on Trust Security and Privacy for Emerging Applications TSP 2016 the 4th International Workshop on Network Optimization and Performance Evaluation NOPE 2016 the Second International Symposium on Dependability in Sensor Cloud and Big Data Systems and Applications DependSys 2016 the Annual Big Data Security Privacy and Trust Workshop BigDataSPT 2016 and the First International Workshop on Cloud Storage Service and Computing WCSSC 2016 The 37 full papers presented were carefully reviewed and selected from 95 submissions The papers deal with research findings ideas and emerging trends in information security research and cover a broad range of topics in security privacy and anonymity in computation communication and storage   Privacy and Identity Management Michael Friedewald,Stefan Schiffner,Stephan Krenn,2021-03-31 This book contains selected papers presented at the 15th IFIP WG 9 2 9 6 11 7 11 6 SIG 9 2 2 International Summer School on Privacy and Identity Management held in Maribor Slovenia in September 2020 The 13 full papers included in this volume were carefully reviewed and selected from 21 submissions Also included is a summary paper of a tutorial As in previous years one of the goals of the IFIP Summer School was to encourage the publication of thorough research papers by students and emerging scholars The papers combine interdisciplinary approaches to bring together a host of perspectives such as technical legal regulatory socio economic social or societal political ethical anthropological philosophical or psychological perspectives The summer school was held virtually

Multi-dimensional Urban Sensing Using Crowdsensing Data Chaocan Xiang,Panlong Yang,Fu Xiao,Xiaochen Fan,2023-03-23 Chaocan Xiang is an Associate Professor at the College of Computer Science Chongqing University China He received his bachelor s degree and Ph D from Nanjing Institute of Communication Engineering China in 2009 and 2014 respectively He subsequently studied at the University of Michigan Ann Arbor in 2017 supervised by Prof Kang G Shin IEEE

Life Fellow ACM Fellow His research interests mainly include UAVs vehicle based crowdsensing urban computing Internet of Things Artificial Intelligence and big data He has published more than 50 papers including over 20 in leading venues such as IEEE Transactions on Mobile Computing IEEE Transactions on Parallel and Distributed Systems IEEE INFOCOM and ACM Ubicomp He has received a best paper award and a best poster award at two international conferences Panlong Yang is a full Professor at the University of Science and Technology of China He has been supported by the NSF Jiangsu through a Distinguished Young Scholarship and was honored as a CCF Distinguished Lecturer in 2015 He has published over 150 papers including 40 in CCF Class A Since 2012 he has supervised 14 master s and Ph D candidates including two excellent dissertation winners in Jiangsu Province and the PLA education system He has been supported by the National Key Development Project and NSFC projects He has nominated by ACM MobiCom 2009 for the best demo honored mention awards and won best paper awards at the IEEE MSN and MASS He has served as general chair of BigCom and TPC chair of IEEE MSN In addition he has served as a TPC member of INFOCOM CCF Class A and an associate editor of the Journal of Communication of China He is a Senior Member of the IEEE 2019 Fu Xiao received his Ph D in Computer Science and Technology from the Nanjing University of Science and Technology Nanjing China in 2007 He is currently a Professor and Dean of the School of Computer Nanjing University of Posts and Telecommunications He has authored more than 60 papers in respected conference proceedings and journals including IEEE INFOCOM ACM Mobihoc IEEE JASC IEEE ACM ToN IEEE TPDS IEEE TMC etc His main research interest is in the Internet of Things He is a member of the IEEE Computer Society and the Association for Computing Machinery Xiaochen Fan received his B S degree in Computer Science from Beijing Institute of Technology Beijing China in 2013 and his Ph D from the University of Technology Sydney NSW Australia in 2021 His research interests include mobile pervasive computing deep learning and Internet of Things IoT He has published over 25 peer reviewed papers in high quality journals and IEEE ACM international conference proceedings   Cloud Computing and Security Xingming Sun,Zhaoqing Pan,Elisa Bertino,2018-09-21 This six volume set LNCS 11063 11068 constitutes the thoroughly refereed conference proceedings of the 4th International Conference on Cloud Computing and Security ICCCS 2018 held in Haikou China in June 2018 The 386 full papers of these six volumes were carefully reviewed and selected from 1743 submissions The papers cover ideas and achievements in the theory and practice of all areas of inventive systems which includes control artificial intelligence automation systems computing systems electrical and informative systems The six volumes are arranged according to the subject areas as follows cloud computing cloud security encryption information hiding IoT security multimedia forensics   *Security and Privacy Issues for IoT and WSN-based Real-time Applications* Manoj Tolani,Arun Balodi,Ambar Bajpai,Vishal Jain,Piya Kovintavewat,2025-06-16 This book explores the security and privacy challenges associated with real time applications of the Internet of Things IoT and wireless sensor networks WSN technologies It provides detailed insights into the unique security and privacy concerns such as malicious attacks data

breaches insider threats and privacy breaches that arise in the context of real time applications like in smart homes smart cities industrial automation healthcare and other time sensitive domains to offer practical solutions and strategies to mitigate these risks Covers various aspects of security and privacy including authentication access control data integrity confidentiality availability threat detection and mitigation privacy preserving techniques Investigates the possibilities of cross layer approaches to address the specific requirements of real time applications and develop innovative solutions Gaining insights into fundamental limits through information theoretic research new protocol designs are developed to access the medium in an energy efficient manner to improve the performance and reliability of WSN and IoT networks for real time applications Discusses the sustainable requirements of emerging real time applications such as low energy consumption and high data rates Offers an interdisciplinary approach that encompasses areas of communication networking and information theory to guide real life deployment of IoT WSN based monitoring systems It is a valuable reference for readers who want to gain a deeper understanding of the challenges and solutions related to the security and privacy of IoT and WSN in the context of real time applications **Proceedings of the 14th International Conference on Computer Engineering and Networks** Guangqiang Yin,Xiaodong Liu,Jian Su,Yangzhao Yang,2025-06-16 This conference proceedings is a collection of papers accepted for CENet2024 the 14th International Conference on Computer Engineering and Networks held in Kashi China 18 21 October 2024 The topics covered include Internet of Things and Smart Systems Artificial Intelligence and Applications Detection Analysis and Application of Communication Systems Cloud Computing and Security and Medical Engineering and Information Systems Each section of this book can serve as an excellent reference for industry practitioners university faculty research fellows undergraduate and graduate students who wish to build a knowledge base of the latest advances and state of the art practices in the topics covered Using this knowledge they will be able to design implement and manage systems that are both complex and trustworthy We would like to thank the authors for their hard work and dedication and the reviewers for their efforts in ensuring that only the highest quality papers were selected Without their contributions the proceedings would not have been possible *Cyber Crime: Concepts, Methodologies, Tools and Applications* Management Association, Information Resources,2011-11-30 Threatening the safety of individuals computers and entire networks cyber crime attacks vary in severity and type Studying this continually evolving discipline involves not only understanding different types of attacks which range from identity theft to cyberwarfare but also identifying methods for their prevention Cyber Crime Concepts Methodologies Tools and Applications is a three volume reference that explores all aspects of computer based crime and threats offering solutions and best practices from experts in software development information security and law As cyber crime continues to change and new types of threats emerge research focuses on developing a critical understanding of different types of attacks and how they can best be managed and eliminated *Issues in Transportation Research and Application: 2013 Edition* ,2013-05-01 Issues in Transportation Research and Application

2013 Edition is a ScholarlyEditions book that delivers timely authoritative and comprehensive information about Transport Geography The editors have built Issues in Transportation Research and Application 2013 Edition on the vast information databases of ScholarlyNews You can expect the information about Transport Geography in this book to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Issues in Transportation Research and Application 2013 Edition has been produced by the world s leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at http www ScholarlyEditions com

Proceedings of International Conference on Computational Intelligence, Data Science and Cloud Computing Valentina E. Balas,Aboul Ella Hassanien,Satyajit Chakrabarti,Lopa Mandal,2021-04-05 This book includes selected papers presented at International Conference on Computational Intelligence Data Science and Cloud Computing IEM ICDC 2020 organized by the Department of Information Technology Institute of Engineering Management Kolkata India during 25 27 September 2020 It presents substantial new research findings about AI and robotics image processing and NLP cloud computing and big data analytics as well as in cyber security blockchain and IoT and various allied fields The book serves as a reference resource for researchers and practitioners in academia and industry   Computational Science and Its Applications – ICCSA 2021 Osvaldo Gervasi,Beniamino Murgante,Sanjay Misra,Chiara Garau,Ivan Blečić,David Taniar,Bernady O. Apduhan,Ana Maria A. C. Rocha,Eufemia Tarantino,Carmelo Maria Torre,2021-09-09 The ten volume set LNCS 12949 12958 constitutes the proceedings of the 21st International Conference on Computational Science and Its Applications ICCSA 2021 which was held in Cagliari Italy during September 13 16 2021 The event was organized in a hybrid mode due to the Covid 19 pandemic The 466 full and 18 short papers presented in these proceedings were carefully reviewed and selected from 1588 submissions Part VIII of the set includes the proceedings of the following workshops International Workshop on Privacy in the Cloud Edge IoT World PCEIoT 2021 International Workshop on Processes methods and tools towards RE Silient cities and cultural heritage prone to SOD and ROD disasters RES 2021 International Workshop on Risk resilience and sustainability in the efficient management of water resources approaches tools methodologies and multidisciplinary integrated applications RRS 2021 International Workshop on Scientific Computing Infrastructure SCI 2021 International Workshop on Smart Cities and User Data Management SCIDAM 2021   **Security and Privacy in Mobile Information and Communication Systems** Ramjee Prasad,Károly Farkas,Andreas U. Schmidt,Antonio Lioy,Giovanni Russello,Flaminia Luccio,2012-04-29 This book constitutes the thoroughly refereed post conference proceedings of the Third International ICST Conference on Security and Privacy in Mobile Information and Communication Systems MOBISEC 2011 held in Aalborg Denmark in May 2011 The 15 revised full papers were carefully selected from numerous submissions and cover the most active areas of research in mobile

security with its 3 focus areas machine to machine communication security policies for mobile environments and mobile user authentication and authorization **Fog/Edge Computing For Security, Privacy, and Applications** Wei Chang,Jie Wu,2021-01-04 This book provides the state of the art development on security and privacy for fog edge computing together with their system architectural support and applications This book is organized into five parts with a total of 15 chapters Each area corresponds to an important snapshot The first part of this book presents an overview of fog edge computing focusing on its relationship with cloud technology and the future with the use of 5G communication Several applications of edge computing are discussed The second part of this book considers several security issues in fog edge computing including the secure storage and search services collaborative intrusion detection method on IoT fog computing and the feasibility of deploying Byzantine agreement protocols in untrusted environments The third part of this book studies the privacy issues in fog edge computing It first investigates the unique privacy challenges in fog edge computing and then discusses a privacy preserving framework for the edge based video analysis a popular machine learning application on fog edge This book also covers the security architectural design of fog edge computing including a comprehensive overview of vulnerabilities in fog edge computing within multiple architectural levels the security and intelligent management the implementation of network function virtualization enabled multicasting in part four It explains how to use the blockchain to realize security services The last part of this book surveys applications of fog edge computing including the fog edge computing in Industrial IoT edge based augmented reality data streaming in fog edge computing and the blockchain based application for edge IoT This book is designed for academics researchers and government officials working in the field of fog edge computing and cloud computing Practitioners and business organizations e g executives system designers and marketing professionals who conduct teaching research decision making and designing fog edge technology will also benefit from this book The content of this book will be particularly useful for advanced level students studying computer science computer technology and information systems but also applies to students in business education and economics who would benefit from the information models and case studies therein **Privacy-Preserving in Edge Computing** Longxiang Gao,Tom H. Luan,Bruce Gu,Youyang Qu,Yong Xiang,2021-06-01 With the rapid development of big data it is necessary to transfer the massive data generated by end devices to the cloud under the traditional cloud computing model However the delays caused by massive data transmission no longer meet the requirements of various real time mobile services Therefore the emergence of edge computing has been recently developed as a new computing paradigm that can collect and process data at the edge of the network which brings significant convenience to solving problems such as delay bandwidth and off loading in the traditional cloud computing paradigm By extending the functions of the cloud to the edge of the network edge computing provides effective data access control computation processing and storage for end devices Furthermore edge computing optimizes the seamless connection from the cloud to devices which is considered the foundation for realizing the

interconnection of everything However due to the open features of edge computing such as content awareness real time computing and parallel processing the existing problems of privacy in the edge computing environment have become more prominent The access to multiple categories and large numbers of devices in edge computing also creates new privacy issues In this book we discuss on the research background and current research process of privacy protection in edge computing In the first chapter the state of the art research of edge computing are reviewed The second chapter discusses the data privacy issue and attack models in edge computing Three categories of privacy preserving schemes will be further introduced in the following chapters Chapter three introduces the context aware privacy preserving scheme Chapter four further introduces a location aware differential privacy preserving scheme Chapter five presents a new blockchain based decentralized privacy preserving in edge computing Chapter six summarize this monograph and propose future research directions In summary this book introduces the following techniques in edge computing 1 describe an MDP based privacy preserving model to solve context aware data privacy in the hierarchical edge computing paradigm 2 describe a SDN based clustering methods to solve the location aware privacy problems in edge computing 3 describe a novel blockchain based decentralized privacy preserving scheme in edge computing These techniques enable the rapid development of privacy preserving in edge computing

Privacy Preservation in Distributed Systems Guanglin Zhang,Ping Zhao,Anqi Zhang,2024-05-30 This book provides a discussion of privacy in the following three parts Privacy Issues in Data Aggregation Privacy Issues in Indoor Localization and Privacy Preserving Offloading in MEC In Part 1 the book proposes LocMIA which shifts from membership inference attacks against aggregated location data to a binary classification problem synthesizing privacy preserving traces by enhancing the plausibility of synthetic traces with social networks In Part 2 the book highlights Indoor Localization to propose a lightweight scheme that can protect both location privacy and data privacy of LS In Part 3 it investigates the tradeoff between computation rate and privacy protection for task offloading a multi user MEC system and verifies that the proposed load balancing strategy improves the computing service capability of the MEC system In summary all the algorithms discussed in this book are of great significance in demonstrating the importance of privacy **Security and Privacy Vision in 6G** Pawani Porambage,Madhusanka Liyanage,2023-08-08 SECURITY AND PRIVACY VISION IN 6G Prepare for the future of mobile communication with this comprehensive study 6G is the next frontier in mobile communication with development of 6G standards slated to begin as early as 2026 As telecommunications networks become faster and more intelligent security and privacy concerns are critical In an increasingly connected world there is an urgent need for user data to be safeguarded and system security enhanced against a new generation of threats Security and Privacy Vision in 6G provides a comprehensive survey of these threats and the emerging techniques for safeguarding against them It includes mechanisms for prediction detection mitigation and prevention such that threats to privacy and security can be forestalled at any stage Fully engaged with proposed 6G architectures it is an essential resource for mobile communications professionals looking for

a head start on the technology of the future Security and Privacy Vision in 6G readers will also find Detailed coverage of topics including edge intelligence and cloudification industrial automation collaborative robots and more Treatment balancing the practical and the theoretical An editorial team with decades of international network technology experience in both industry and academia Security and Privacy Vision in 6G is a vital reference for network security professionals and for postgraduate and advanced undergraduate students in mobile communications and network security related fields

Security and Privacy in Smart Sensor Networks Maleh, Yassine,Ezzati, Abdellah,Belaissaoui, Mustapha,2018-05-09 Security and privacy protection within computer networks can be a challenge By examining the current problems and challenges this domain is facing more efficient strategies can be established to safeguard personal information against invasive pressures Security and Privacy in Smart Sensor Networks is a critical scholarly resource that examines recent developments and emerging trends in smart sensor security and privacy by providing new models practical solutions and technological advances related to security Featuring coverage on a broad range of topics such as cloud security encryption and intrusion detection systems this book is geared towards academicians engineers IT specialists researchers and students seeking current research on authentication and intrusion detection **Intelligent Technologies and Techniques for Pervasive Computing** Kolomvatsos, Kostas,2013-05-31 Pervasive computing enables users to interact with information resources in their everyday lives The development of computational technologies that can exist in ever smaller devices while simultaneously increasing processing power allows such devices to blend seamlessly into tangible environments Intelligent Technologies and Techniques for Pervasive Computing provides an extensive discussion of such technologies theories and practices in an attempt to shed light on current trends and issues in the adaption of pervasive systems Within its pages students and practitioners of computer science will find both recent developments and practical applications an overview of the field and how intelligent techniques can help to improve user experience in the distribution and consumption of pertinent timely information This book is part of the Advances in Computational Intelligence and Robotics series collection

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