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##### Abstract:

Telecommunication services have been developing at a continuously accelerating pace, and it is forecasted that it will accelerate even more, that is particularly so for the wireless communication system with the introduction of 4G and 5G and the integration of the Internet of Things (IoT). Microstrip patch antennas present undeniable advantages when compared to other antennas such as low cost, compact, planar surface, flexibility in performance parameters and easy fabrication. Such advantages have made these antennas so popular. The main objective of this research is to design an antenna operating at multiple frequencies with high performance. This paper discusses design of compact multiband antenna with microstrip-line-feed designed for future wireless devices applications. The introduced antenna is simulated using Rogers RT-5880 substrate of having dimensions  $21 \times 16 \times 0.507 \text{ mm}^3$  with dielectric value 2.2 and 0.0009 tangent loss. Planned patch antenna operates initially at 10GHz with return loss -11.19dB and VSWR 1.76. I shaped slots on patch and defective ground structure technique is employed for multiband operation and improvement in performance parameters. Multiband antenna resonates frequencies 10, 21, 30 and 34 GHz with return loss -19 dB, -12dB, -12dB, -11 dB and VSWR 1.2, 1.5, 1.6, 1.82. International Telecommunication Union (ITU) specified these frequencies for radio astronomy, wireless LAN, satellite communications, DBS applications. Designed antenna provides gain 7.785dB, 3.508 dB, 7.510 dB, 7.7746 dB at 10,21,30,34GHz respectively.

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☰ Contents

I. Introduction

In recent years rapid growth in wireless industry initiated demand for large scale growth of efficient mobile device and good performance communication network, thus require high efficiency in the antenna design as it is basic part of every wireless system. Expected is designed antenna should be compact. For multi functionalities we need to design multiband antenna to fulfil various wireless devices need. Thus, there is a need to design a multiband antenna to work at multiple frequencies. Microstrip patch antennas are one of the basic elements of today wireless communication. Requiring future generation portable devices conversation is waiting to meet potential never attained earlier [2]. It's demanded stipulations are including huge bit rate, better utilization of frequency spectrum and lower latency [3]. Upcoming mobile radio intelligence chain (5G) [4], [5], [6] are predicted to build a footprint along supporting multiple functionalities and advantages compared to particulars what 4G offered. Leading communication system would connect entire world and stow the support for a world-wide web.

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## Chapter




## Importance and Use of Microstrip Antennas in IoT

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Amit Kumar  
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Hyderabad, India

Stefan Mozar  
Dynexsys  
Sydney, NSW, Australia

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# Preface

Cyber-physical systems (CPS) are hybrid systems that use computation, networking, and physical processes to perform tasks. With feedback loops in place where physical processes affect computations and calculations affect physical processes, embedded computers and networks can both monitor and regulate physical processes. There is significant unrealized economic and societal potential in such systems, and significant investments are being made around the world to further improve the technology and make it more accessible. The technique is based on the older (but still very young) science of embedded systems, which involves placing computers and software in objects whose primary function is not computation, such as automobiles, toys, medical equipment, and scientific instruments, among other things. When the dynamics of physical processes are combined with those of software and networking, the result is CPS, which provides abstractions as well as modelling, design, and analysis approaches for the integrated whole.

CPS is an engineering profession that is primarily concerned with technology, and it has a solid base in abstract mathematical concepts. In computer science, the primary technological difficulty is to combine abstractions that have evolved over centuries for modelling physical processes (differential equations, stochastic processes, and so on) with abstractions that have grown over decades for modelling computer-based processes (algorithms and programs, which provide a “procedural epistemology” [Abelson and Sussman]). The former abstractions are concerned with dynamics (the evolution of a system’s state over time), whereas the later are concerned with data transformation operations. Based on the Turing–Church theory of computability, computer science abstracts away fundamental physical features, particularly the passage of time, that are essential to include the dynamics of the physical world in a discourse on language and logic.

We are entering a new era of computing technology. Machine to machine communication, machine to infrastructure communication, machine to environment communication, cyber-physical systems, Internet of everything communication, and Internet of intelligent things communication.

This book contains selected and presented papers from the International Conference on Communications and Cyber-Physical Engineering, 2021, which took place

at CMR Engineering College, Hyderabad, on April 9 and 10. It comprises of carefully chosen manuscripts that have been grouped according to their approaches and contributions to the conference's scope and theme. The algorithms and theories presented in the chapters of this book are at the heart of the technologies and applications covered, which are primarily face recognition, evolutionary algorithms such as genetic algorithms, automotive applications, automation devices with artificial neural networks, business management systems, the Internet of things, machine learning, data science, and modern speech processing systems. This book also covers contemporary advancements in medical diagnostic systems, sensor networks, and VLSI domain systems, among other topics. Whenever possible, a discussion of deep learning algorithms' learning and software modules is included when appropriate. Briefly stated, the book will provide insights into the technological breakthroughs involved in cyber-physical systems and engineering.

Hyderabad, India  
Sydney, Australia

Amit Kumar, Ph.D.  
Stefan Mozar

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# Lecture Notes in Electrical Engineering

## Volume 855

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# Recent Innovations in Computing

Proceedings of ICRIC 2021, Volume 2

*Editors*

Pradeep Kumar Singh  
KIET Group of Institutions  
Ghaziabad, India

Jitender Kumar Chhabra  
Department of Computer Engineering  
NIT Kurukshetra  
Kurukshetra, India

Chaman Verma  
Faculty of Informatics  
Eötvös Loránd University (ELTE)  
Budapest, Hungary

Yashwant Singh  
Department of CSE  
Central University of Jammu  
Jammu and Kashmir, India

Zoltán Illés  
Faculty of Informatics  
Eötvös Loránd University (ELTE)  
Budapest, Hungary

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# Preface

The fourth version of international conference was hosted on the theme Recent Innovations in Computing (ICRIC 2021), the conference was hosted by the Eötvös Loránd University (ELTE), Hungary in association with Knowledge University, Erbil, WSG University in Bydgoszcz, Poland and other academic associates, technical societies, IAC and other universities from India and abroad. The conference covers the tracks; advanced computing, intelligent networking, image processing and computer vision, e-learning, cloud and big data, security and privacy, and Digital India. The researchers were invited to present their research ideas at the Fourth International Conference on Recent Innovations in Computing (ICRIC 2021) on these tracks during two days of conference 8th to 9th June, 2021. We appreciate our valuable writers' contributions, as well as our Technical Program Committee's tremendous support and inspiration in making the 4th ICRIC 2021 a success. The conference was started with the opening remark of Dr. Zoltán Illés, Eötvös Loránd University (ELTE), Hungary. He welcomes all the participants and session chairs along with the keynotes. Knowledge University, Erbil was the academic partner for the conference and the inaugural speech with keynote was delivered by Dr. Kayhan Zrar Ghafour, who is currently serving as a president of Knowledge University. Dr. Zdzislaw Polkowski delivers his talk on behalf of WSG University in Bydgoszcz, Poland.

We would like to express our sincere gratitude to our all session chairs— Prof. Jitendra Kumar Chhabra, NIT Kurukshetra, Dr. Arpan K.Kar, IIT Delhi; Dr. Maheshkumar H. Kolekar, IIT Patna; Prof. Manu Sood, Himachal Pradesh University; and Prof. Sudeep Tanwar, Nirma University, India, Dr. Ashutosh Sharma, Dr. Aruna Malik and Dr. Samayveer Singh from NIT Jalandhar, India. Dr. Ashima, Dr. Sumit Kumar, Dr. Nagesh Kumar, Dr. Vivek Sehgal, Dr. Yugal Kumar Chaired the session during the technical presentations. Dr. Veronika Stoffova, Trnava University in Trnava, Slovakia delivered a short speech followed by the session chair during the conference. Dr. Viktória Bakonyi, University of Eötvös Loránd, Hungary, and Dr. Chaman Verma from ELTE Hungary chaired the technical session and carried out a short panel discussion for the participants. Dr. Pljonkin Anton Pavlovich, Southern Federal University, Russia and Dr. Ashutosh Mishra, Yonsei University, South Korea also took part in panel discussion during the conference and chaired the technical

sessions as well. The last session during the conference was chaired by the Dr. Maria Simona Raboaca, Faculty of Electrical Engineering and Computer Science, University of Suceava, Romania and Dr. Praveen Kumar Singh, UIDAI, Lucknow, India.

We are also grateful to Eötvös Loránd University (ELTE), Hungary management board, rectors, vice rectors, deans, and professors for extending their help during the conference. Many other professors from different countries also deserve our gratitude for devoting their time to listen the paper presentations and for giving their valuable feedback to the authors. We extend our thanks to the Springer, LNEE Series, editorial board for believing in us.

Ghaziabad, India  
Jammu and Kashmir, India  
Kurukshetra, India  
Budapest, Hungary  
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June 2021

Pradeep Kumar Singh  
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Jitender Kumar Chhabra  
Zoltán Illés  
Chaman Verma

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## About the Editors

**Dr. Pradeep Kumar Singh** is currently working as Professor and Head in the department of CS at KIET Group of Institutions, Delhi-NCR, Ghaziabad, India. Dr. Singh is Life Membership of Computer Society of India (CSI), Life Member of IEI and promoted to Senior Member Grade from CSI and ACM. He is Associate Editor of the International Journal of Information System Modeling and Design (IJISMD), Indexed by Scopus and Web of Science. He is also Associate Editor of International Journal of Applied Evolutionary Computation (IJAEC), IGI Global USA, Security and Privacy, Wiley & International Journal of Information Security and Cybercrime (IJISC) a scientific peer-reviewed journal from Romania. He has published nearly 122 research papers in various International Journals and Conferences of repute. Some of his publications are in, e.g., IEEE Access, Applied Intelligence, Multimedia Tools and Applications, and Computer Communications. He has received three sponsored research projects grant from Govt. of India and Govt. of HP worth Rs 25 Lakhs. He has edited a total 12 books from Springer and Elsevier. He has Google scholar citations 1450, H-index 17, and i-10 Index 45.

**Dr. Yashwant Singh** is Head & Associate Professor in the Department of Computer Science & Information Technology at the Central University of Jammu.

Yashwant completed his Ph.D. from Himachal Pradesh University Shimla, his post Graduate study from Punjab Engineering College Chandigarh and undergraduate studies from SLIET Longowal. His research interests lie in the area of Internet of Things, Vulnerability Assessment of IoT and Embedded Devices, Wireless Sensor Networks, Secure and Energy Efficient Routing, ICS/SCADA Cyber Security, ranging from theory to design to implementation. He has collaborated actively with researchers in several other disciplines of computer science, particularly Machine Learning, Electrical Engineering.

Yashwant has served on Thirty International Conference and Workshop Program Committees and served as the General Chair for PDGC-2014, ICRIC-2018, ICRIC-2019, ICRIC-2020, and ICRIC-2021. He currently serves as coordinator of Kalam Centre for Science and Technology (KCST), Computational Systems Security Vertical at Central University of Jammu established by DRDO.

Yashwant has published more than 80 Research Papers in the International Journals, International Conferences and Book Chapters of repute that are indexed in SCI and SCOPUS. He has 548 Citations, i10-index 23 and h-index 14. He has Research Projects worth Rs.46.322 Lakhs in his credit from DRDO and Rs. 12.19 Lakhs from NCW. He has guided 4 Ph.Ds., 24 M.Tech. students and supervising 4 Ph.Ds. and 6 M.Tech.

Dr. Yashwant Has visited 8 countries for his academic visits e.g. U.K., Germany, Poland, Czech Republic, Hungary, Slovakia, Austria, Romania. He is Visiting Professor at Jan Wyzykowski University, Polkowice, Poland.

**Prof (Dr.) Jitender Kumar Chhabra** is Professor, Computer Engineering Department at National Institute of Technology, Kurukshetra India. He has published 120 papers in reputed International and National Journals and conferences including more than 40 publications from IEEE, ACM, Elsevier and Springer, most of which are SCI/Scopus indexed. His research interest includes Software Metrics, Data Mining, Soft Computing, Machine Learning, Algorithms & related areas. He is Reviewer for most reputed journals such as IEEE Transactions, ACM Transactions, Elsevier, Wiley, and Springer. He has total 1122 Google Scholar Citations, H-Index 16, and i-10 Index 24.

**Dr. Zoltán Illés, Ph.D.** Habil. has started higher education studies in subjects Mathematics and Physics at Eötvös Loránd University. He later took up the Computer Science supplementary course, which was started at that time. He got a Hungarian's Republic scholarship based on his outstanding academic achievements during his university studies. He graduated in 1985, after which he started working at the Department of Computer Science of Eötvös Loránd University. He completed his Ph.D. dissertation entitled "Implementation of Real-Time Measurements for High-Energy Ion Radiations" in 2001. In 2004, at the request of Jedlik Publisher, he also wrote a textbook on the C# programming language. This book has a second, expanded edition in 2008. In 2007, he was awarded a scholarship by the Slovak Academy of Sciences, where he spent six months researching and teaching at the Constantine the Philosopher University in Nitra. The NJSZT awarded the Rezső Tarján Prize in 2016 for the success of the joint work that has been going on ever since. He and his colleagues also researched the issue of mobile devices and applications in the framework of a TÉT\_SK tender won in 2014. Based on their research findings, he launched a pilot project to support real-time, innovative performance management. The first results of this research are an integral part of his habilitation dissertation. He has been Invited Speaker at several international conferences and Member of the Amity University Advisory Board since 2020.

**Dr. Chaman Verma, Ph.D.** is working as Faculty/Computer Research Scientist and Professional Assistant in the Department of Media and Educational Informatics, Faculty of Informatics, Eötvös Loránd University, Hungary. He has been awarded scholarship ÚNKP, MIT (Ministry of Innovation and Technology) and

National Research, Development and Innovation (NRDI) Fund, Hungarian Government. Additionally, He won the EFOP scholarship of the European Social Fund under the project: “Talent Management in Autonomous Vehicle Control Technologies” sponsored by the European Union and Hungarian Government. He was also nominated and awarded a scientific publication award in 2021 at the Faculty of Informatics, Eötvös Loránd University, Hungary. He got the best research paper awards at IEEE Conefrnce, Uzbekistan (2021), and Springer Conefrnce, CDAC, India (2020). His Ph.D. has been sponsored under the Stipendium Hungaricum Scholarship of Tempus Public Foundation, Government of Hungary. He has completed his M.Tech. in Computer Science and Engineering from Ch. Devi Lal University, Haryana, India. He has around 10 years of teaching and industry experience. He has more than 60 scientific publications in the IEEE, Elsevier, Springer, IOP Science, MDPI, and Walter de Gruyter. His research interests include statistical analysis, machine learning, deep learning, optimization and feature engineering, real-time systems, and educational informatics. He is a guest editor for Special Issue “Advancements in Machine Learning and Statistical Modeling, and Real-World Applications” in Mathematics Journal, MDPI, Basel, Switzerland. He is a Member of the Editorial Board and a Reviewer of various international journals and scientific conferences. He is a Life Member of ISTE, New Delhi, India. He is a reviewer of many scientific journals of IEEE, Springer, Elsevier, Wiley, MDPI. He has Scopus citations 405 with H-index 12. He has Web of Science citations 90 with H-index 6. He has google citations 613 with H-index 15, i10-index 23.