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Contents

Extremely High-Capacity, Secure Image Steganography Based on Composite Edge Detection, with Message Integrity 1
Priyanka Yadav and A. K. Mohapatra

A Dynamic Hand Gesture-Based Password Recognition System 21
Manasa Pisipati, Amrit Puhan, Arun Kumar, Vijay Bhaskar Semwal and Himanshu Agrawal

Fuzzy Concepts and Machine Learning Algorithms for Car Park Occupancy and Route Prediction 35
Mani V. Sumini, Jaison Mulerikkal, P. B. Ramkumar and Paulsy Tharakan

A Distributed Algorithm to Create a Minimum Spanning Tree in a Multi-channel Cognitive Radio Network 53
Deepak Rohilla and Mahendra Kumar Murmu

A Distributed Fault Analysis (DFA) Method for Fault Tolerance in High-Performance Computing Systems 61
G. Sreenivasulu, P. V. S. Srinivas and A. Goverdhan

Ontology-Driven Framework to Automatically Generate University Timetable 77
Shruti Bajpai and Amrita Chaturvedi

A Survey on Task Scheduling and Resource Allocation Methods in Fog Based IoT Applications 89
V. Sindhu and M. Prakash

Improved Linear Extrapolation Technique for Crop Health Monitoring Using Hyperspectral Data 99
Anjana Ghule and R. R. Deshmukh

Stratified Sampling-Based Data Reduction and Categorization Model for Big Data Mining 107
Kamlesh Kumar Pandey and Diwakar Shukla

Product Sentiment Analysis Using Natural Language Understanding 123
Prachi Ayare, Ranjnishkaur Sachdeo and Milind Penurkar

Software Cost Estimation for Python Projects Using Genetic Algorithm 137
Amrita Sharma and Neha Chaudhary

Prediction of Rise in Violence Inclined Opinions: Utility of Sentiment Analysis in the Modern World 149
Khushboo Sansanwal, Mamta Mittal and Lalit Mohan Goyal

Face Tagging and Recognition Using Inception Network and Triplet Loss Generator Function 161
Shreya Kumari, Prachi Pandey and Maroti Deshmukh

Analyses of Factors Influencing Contraceptive Methods and Predicting the Use of Method of Contraception 175
Sawant Rupali and Bakal Jagdish

Off-the-Record (OTR) Security Protocol Application in Cloud Environment 195
Leo Mrsic, Jurica Adamek and Ivan Cicek

Agricultural Marketing Transformation Through Crowdsourcing System for Product Price Analysis 207
Shambel Yilma Arega, Abhishek Ray and Prachet Bhuyan

Malware Detection Using Multilevel Ensemble Supervised Learning 219
Vidhi Garg and Rajesh Kumar Yadav

Image Splicing Forgery Detection Using DWT and Local Binary Pattern 233
Pooja Sahani Jaiprakash, Choudhary Shyam Prakash and Madhavi Desai

Discrete-Time Analysis of Communication Networks with Second Optional Service and Negative User Arrivals 243
Rakhee and Shruti

Emoticon Prediction on Textual Data Using Stacked LSTM Model 259
Mamta Mittal, Maanak Arora and Tushar Pandey

A Survey on Computational Intelligence Techniques for Internet of Things 271
J. Shreyas and S. M. Dilip Kumar

A Comparative Analysis of Over-the-Top Platforms: Amazon Prime Video and Netflix 283
Advait Lad, Shivani Butala and Pramod Bide

An Empirical Analysis on Retrieval of Math Information from the Scientific Documents 301
Pankaj Dadure, Partha Pakray and Sivaji Bandyopadhyay

Imposition and Transmission of QPSK Communication Through LabVIEW Using USRP 309
Riya Chordia, Ronak Gupta, M. Ramya and A. Rajeswari

Reflection of IoT Ubiquitous Connectivity and Security in Cross-industry Collaboration 323
Priyanka Mekala, Supriya Goel and Swapnil Sutar

A Computationally Efficient Data-Dependent Projection for Dimensionality Reduction 339
Raghunadh Pasunuri and Vadlamudi China Venkaiah

Probabilistic-Based Energy-Efficient Single-Hop Clustering Technique for Sensor Networks 353
Khushboo Jain, Anoop Kumar and Chandra Kumar Jha

RFID-Based Smart Shopping in IoT Environment: A Way to Become a Smart Shopper 367
Rahul Chauhan, Divya Punj and R. C. Joshi

Area Optimized High-Level Synthesis of Bubble Check Algorithm for Check Node Processing 381
Himanshu Sharma, Manju Choudhary, Vikas Pathak and Ila Roy

Identification and Classification of Expertise Using Eye Gaze—Industrial Use Case Study with Software Engineers 391
K. R. Chandrika, J. Amudha and Sithu D. Sudarsan

Crypto-Wills: Transferring Digital Assets by Maintaining Wills on the Blockchain 407
Jainam Chirag Shah, Mugdha Bhagwat, Dhiren Patel and Mauro Conti

One-Shot Digit Classification Based on Human Concept Learning 417
A. K. Thushar and V. N. Manjunatha Aradhya

Genetic Algorithm Tuned Sizing Scheme for Grid Integrated Hybrid Energy System 425
Lakshaya Maheshwari and Hari Om Bansal

Medical Analysis Methods for Object Identification 435
Ramgopal Kashyap and Surendra Rahamatkar

Low-Cost Smart Home Using Sensor Fusion and Autonomous Wheel Chair: Caring Lonely Elders Specially in India 447
Shatadal Ghosh, C. Manikanta, Ashis Mondal, S. P. Pathak, M. Bagchi and Nataraj Dasgupta

Optimal Reactive Power Dispatch Using Gravitational Search Algorithm to Solve IEEE-14 Bus System 463
Indu Bala and Anupam Yadav

Comparative Analysis of Ensemble Classifier and Single Base Classifier in Medical Disease Diagnosis 475
Samir S. Yadav, Vinod J. Kadam and Shivajirao M. Jadhav

Comparative Study on Punjabi Document Clustering 491
Iknoor Singh, Vijay Paul Singh and Naveen Aggarwal

Appropriateness of Machine Learning Techniques for TCP with MANETs 503
Hardik K. Molia and Amit D. Kothari

Area Optimized High-Level Synthesis of Bubble Check Algorithm for Check Node Processing

Himanshu Sharma, Manju Choudhary, Vikas Pathak and Ila Roy

Abstract This paper presents the high-level synthesis (HLS) of the low complexity algorithm for the check node processing, i.e., bubble check algorithm in non-binary LDPC decoders. After a review of the state-of-the-art, there is a focus on decreasing the hardware requirement for check node processing using HLS. The main problem associated with the check node processing is that it demands a large amount of hardware when it is implemented on an FPGA. HLS optimizes the resultant hardware design because it performs computational scheduling, resource binding and pipelining while mapping code into hardware design. By using directives, the design can be further optimized according to the designer's requirements. This motivated us to use HLS for implementing bubble check algorithm. In this paper, HLS is carried out for Artix-7 FPGA. The synthesis results show that the number of slices required to implement the bubble check algorithm using HLS is 193, which is further reduced to 125 slices by applying directives.

Keywords Non-binary low-density parity-check decoders · Check node processing · Bubble check algorithm · High-level synthesis · Directives

1 Introduction

Low-density parity-check codes [1] also known as LDPC codes are a type of linear block codes which can approach to the Shannon limit. They were developed by R. G. Gallager in the year 1962. But at that time, they were not much used. There were two main reasons behind this. The first reason was that the algorithm which decodes the LDPC codes was having high complexity. The second reason was that the integrated circuits technology was not that much developed in 1960s and 1970s as it is in the present scenario. That is why not much interest was given to these codes. So, as a result, these codes were forgotten for several years. But in the last two decades, the integrated circuit technology was developed at a very fast pace which leads to the rediscovery of these codes. They were rediscovered in 1999 [2]. Presently, binary LDPC codes are used in several applications and standards, like

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