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Dr.V.Murugalakshmi is an Accomplished Academic in English Literature with a Ph.D. from Madurai Kamaraj University. She currently serves as an Associate Professor at P.S.R. Engineering College, Sivakasi. With over 18 years of Teaching Experience, she has held various Academic Positions including Head & Assistant Professor at SRNM College, Sattur. Her areas of expertise include Indian Writing in English, Gender Studies and English Language Teaching. She has published Numerous Research Papers in UGC CARE-listed Journals and Edited Volumes. Her Doctoral Research focused on Ruskin Bond's Portrayal of Indian Culture and Children. She has participated in and organized several National and International Conferences and Seminars. She has received Awards including "Best Professor" from Lions Club International. She has also published Patents related to Language Development and Digital Learning. An Avid Speaker, she has delivered Guest Lectures and presented at Faculty Development Programs Nationwide.

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Dr.B.Balakumar holds a B.Tech in ECE from NIT Hamirpur (2003) and an M.Tech in Computer and IT from MS University (2006). He earned his Ph.D. in Medical Image Processing from Manonmaniam Sundaranar University in 2019. Currently, he serves as an Assistant Professor (Grade III) at the Centre for IT & Engineering, MS University, Tirunelveli. He has published extensively in International Journals and Conferences. He is a reviewer and regional editor for reputed international journals. He is affiliated with BMC, SAGE, and the Journal of the National Cancer Institute. His research interests include Image Processing, Cloud Computing, Cyber Security, and Data Science. He actively supervises Ph.D. scholars in diverse computing and data-driven fields. He is a Life Member of Professional Bodies such as ISTE and CSI. With a passion for innovation, he contributes significantly to both Academia and Applied Research.

Dr.M.Prathapan is an Associate Professor and Research Supervisor in the Department of Commerce at Vels Institute of Science, Technology, and Advanced Studies (VISTAS), Chennai. With over 20 years of Teaching Experience, he has made Significant Contributions to Academia through Research and Publications. He has authored three Books, Published 25 Research Articles, secured Five Patents, and Received Six Academic Achievement Awards. A recognized Ph.D. Supervisor, he has guided Research Scholars and reviewed UGC Post-Doctoral Proposals. Actively involved in Seminars and Conferences, he serves on Editorial Boards of UGC CARE-Listed Journals, shaping the Future of Commerce Education and Research.

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Dr.S.Kanchana has Extensive Teaching Experience Spanning over two Decades. She has been serving as an Assistant Professor in the Department of Computer Science at SRM Institute of Science and Technology, Chennai, since 2012. Prior to this, she worked as a Lecturer in the Department of MCA at Shree Devi Institute of Technology, Mangalore, under VTU, from February 2008 to July 2011. She also contributed as a Lecturer in the Department of Computer Science at Sri Jayendra Saraswathi Centre, Tambaram, from October 2004 to April 2006. She has successfully guided two Ph. D. scholars, with two more nearing Thesis Submission, and has published over 20 Papers in National and International Journals.

Dr.R.Bhuvana has completed her MSC, M.Phil, MCA. Degree from Bharathidasan University in the year 2002 to 2004 & Jan 2011 and Finished her Doctorate in the Year Sep 2014 From VISTAS Chennai. She also Qualified NTA NET in Dec 2021. She is currently working as a Professor in the Department of Computer Science, AM Jain College Chennai. She has 17 years of Experience in both UG & PG level Courses. Her area of specialization is ANN, Machine Learning & Data Mining. She has published more than 35 journals in which 6 are Scopus Indexed. She has presented more than 35 articles in National & International Conferences and also published 8 articles in book chapters also.

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ISBN 978-93-6348-116-9
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Agurchand Manmull Jain College,
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Published by:	**Leilani Katie Publication and PRESS** **Madurai - 625003, Tamil Nadu, India.**
Edition Details:	**I**
ISBN:	**978-93-6348-116-9**
Month & Year:	**May, 2025**
Copyright ©	**Department of Publication and Production** **Leilani Katie Publication and PRESS**
Pages:	**84**
Price:	**₹600/-**

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CONTENT

SECURING MESSAGE TRANSMISSION USING QUOTIENT-REMAINDER LABELED GRAPH AND XOR BINARY FUNCTION

V.Maheswari
Professor,
Department of Mathematics,
Vels Institute of Science, Technology & Advanced Studies (VISTAS),
Chennai, Tamil Nadu, India.

A.Punitha
Assistant Professor,
Department of Mathematics,
Vels Institute of Science, Technology & Advanced Studies (VISTAS),
Chennai, Tamil Nadu, India.

G.Jayaraman
Assistant Professor,
Department of Mathematics,
Vels Institute of Science, Technology & Advanced Studies (VISTAS),
Chennai, Tamil Nadu, India.

Abstract

In this chapter, we introduced Quotient Remainder labeling and studied its use in cycle graphs. Also, a technique for coding and decoding a message utilizing Quotient Remainder labeling with the help of the XOR Binary function was evaluated.

Keywords

Graph Labeling, Quotient Remainder labeling, XOR Binary Function, Cycle Graphs

1. Introduction

Data security during transmission is essential in today's digital world to guard against unwanted access and guarantee message integrity. Quotient-Remainder Labeling (QRL) and the XOR Binary Function combine to provide a straightforward yet efficient method for encoding and decoding messages among lightweight encryption techniques. This method improves the transmitted data's verifiability and security.

Quotient-Remainder Labeling is a mathematical method that creates a quotient and a remainder by dividing the ASCII value of each character by a fixed modulus. These two elements serve as the character's distinct labels or identifiers, which can subsequently be used to confirm that the decoded message is accurate. By adding redundancy, this labeling technique increases transmission reliability and tamper resistance.

The binary representation of each character is then XOR-ed with a fixed binary key to guarantee confidentiality. Applying the same key again yields the original value, making the XOR (exclusive OR) function a simple yet effective cryptography operation that offers reversible encryption. The XOR function gives the message a secure encryption layer when used in conjunction with QRL. All of these methods provide a portable, effective, and verifiable method of sending secure messages, which makes them appropriate for embedded systems, low-power devices, and applications where sophisticated encryption algorithms are impractical.

II. Procedure for Coding and Decoding

Step: 1 A suitable cycle C_n graph is taken. The length of the onetime pad is taken as in the form of binary digits.

Step: 2 we define mapping X: V (G) → {1, 2……. p} and fix the edge values by Quotient Remainder labeling.

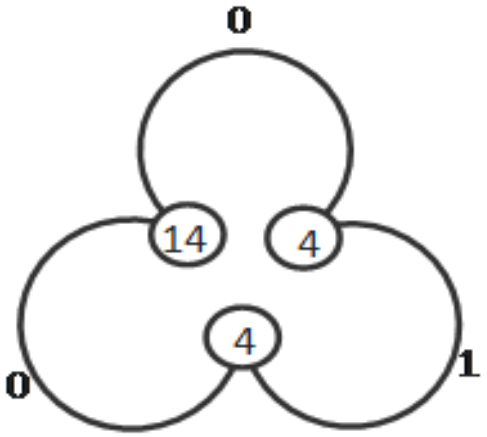

Figure 1

Step: 3 Converting the alphabets into a numerical number as per given in the below table to make our encoding and decoding highly secured.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Step: 4 Select numerical number to the alphabetic "**Plain Text**" and fix it in vertices and the edge value is fixed by quotient remainder labeling. By definition QRL, $\frac{|\Delta_f(0) - \Delta_f(1)|}{2} \leq 1$.

Step: 5 After that we use binary XOR function to cipher the message.

Illustration 1

1. Plain Text- SEE

2. Let us assume One Time Pad-01001001

3. Fix each letter to the vertices of cycle C_n and convert each character into numerical value as in step (3).

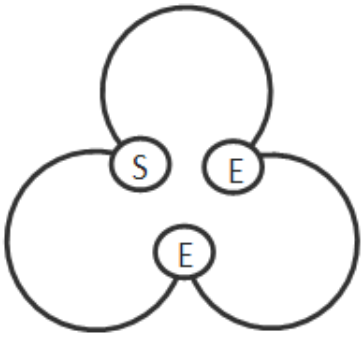

Figure 2

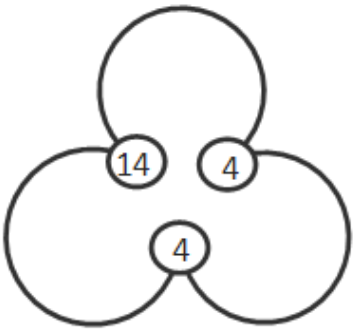

Figure 3

4. In cryptography, XOR cipher is a type of additive cipher, an encryption Method that operates according to the following principles:

U	Function	V	U XOR V
0	XOR	0	0
0	XOR	1	1
1	XOR	0	1
1	XOR	1	0

According to Binary XOR function, we have to convert our message into binary operation as below:

Plain Text	S	E	E
Binary Operation	01010011	01000101	01000101
One Time Pad	01001001	01001001	01001001
Cipher Text	**00011010**	**00001100**	**00001100**

Decryption

For Deciphering, reverse the encoding method as per the below table.

Cipher Text	00011010	00001100	00001100
One Time Pad	01001001	01001001	01001001
Decipher	**01010011**	**01000101**	**01000101**
Plain Text	S	E	E

Procedure for Coding and Decoding

Step: 1 A suitable cycle C_n graph is taken. The length of the onetime pad is taken as in the form of binary digits.

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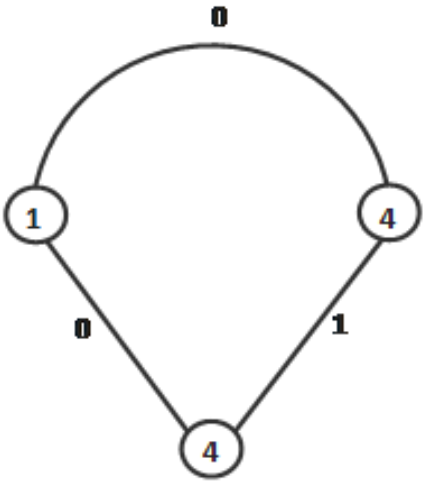

Figure 4

Step: 3 Converting the alphabets into a numerical number as per given in the below table to make our encoding and decoding highly secured.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Step: 4 Select numerical number to the alphabetic "**Plain Text**" and fix it in vertices and the edge value is fixed by quotient remainder labeling. By definition (1.7) $\frac{|\Delta_f(0) - \Delta_f(1)|}{2} \leq 1$.

Step: 5 After that we use binary XOR function to cipher the message.

Illustration 2

1. Plain Text- BEE

2. Let us assume One Time Pad-10110111

3. Fix each letter to the vertices of cycle C_n and convert each character into numerical value as in step (3).

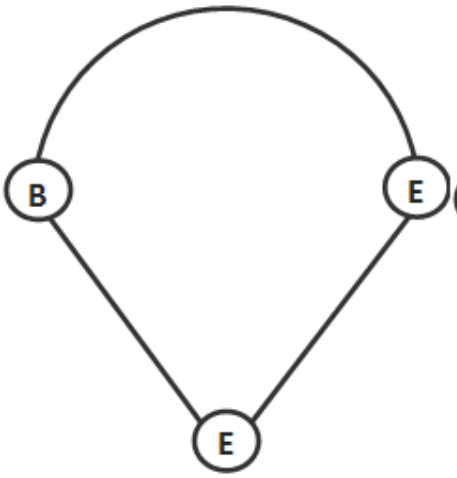

Figure 5

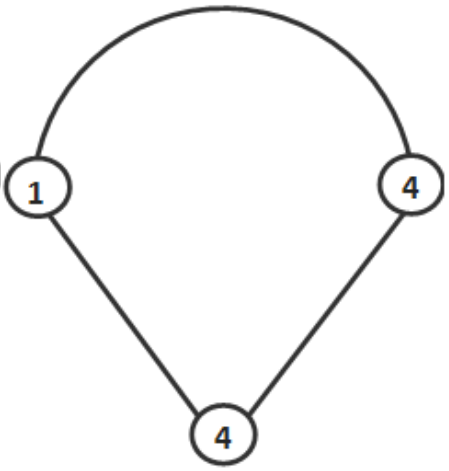

Figure 6

4. In cryptography, XOR cipher is a type of additive cipher, an encryption Method that operates according to the following principles:

U	Function	V	U XOR V
0	XOR	0	0
0	XOR	1	1
1	XOR	0	1
1	XOR	1	0

According to Binary XOR function, we have to convert our message into binary operation as below:

Plain Text	B	E	E
Binary Operation	01000010	01000101	01000101
One Time Pad	10110111	10110111	10110111

Cipher Text	**11110101**	**11110010**	**11110010**

III.Decryption

For Deciphering**,** reverse the encoding method as per the below table.

Cipher Text	11110101	11110010	11110010
One Time Pad	10110111	10110111	10110111
Decipher	**01000010**	**01000101**	**01000101**
Plain Text	B	E	E

Conclusion

Particularly in systems with constrained computational resources, the combination of Quotient-Remainder Labeling (QRL) and the XOR Binary Function offers a workable and efficient way to secure message transmission. Every character in the message is uniquely tagged with a quotient and remainder by utilizing the mathematical simplicity of QRL, offering an integrated validation and error detection mechanism. In addition, the XOR operation provides an additional layer of encryption to guarantee the data's confidentiality. Without using intricate cryptographic algorithms, this hybrid approach improves data security and integrity. Because of its low weight, it is perfect for embedded systems, Internet of Things gadgets, and educational applications where more conventional encryption techniques might not be feasible. With the growth of digital communication, these techniques can be very helpful in preserving.

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