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No	Karya Ilmiah	Judul	Identitas Karya Ilmiah
1	Jurnal Nasional Terakreditasi Sinta 3	Odd Harmonious Labeling of the Zinnia Flower Graphs	Jurnal Ilmiah Sains April 2023, Vol. 23 No. 1, Hal 40-46 1412-3770 (print), 2540-9840 (online) Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado, Indonesia https://ejournal.unsrat.ac.id/v3/index.php/JIS/article/view/46771/42912

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Klaten, 20 Agustus 2024

Hormat Saya,

Fery Firmansah, S.Si., M.Si.

NIP/ NIDN. 198808302015041004/0030088802

Submit ke Jurnal Ilmiah Sains (28 Februari 2023)

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File Name	Date	Type
107051 Jurnal Ilmiah Sains Fery Firmansah Tasari 2023.docx	February 28, 2023	Article Text
107551 46771_Jurnal+Ilmiah+Sains Reviewer.docx	March 7, 2023	Article Text

Below the table, there is a 'Download All Files' button. The 'Pre-Review Discussions' section shows a table with one entry:

Name	From	Last Reply	Replies	Closed
Author statement	jm_jis	2023-06-12 09:51 AM	0	<input type="checkbox"/>

The browser's taskbar at the bottom shows several open documents and the system tray with the date 08/03/2023.

The screenshot shows the 'Title' and 'Abstract' sections of the JURNAL ILMIAH SAINS author dashboard. The page has a dark blue header with the journal name and a 'Back to Submissions' link. Below the header, there are tabs for 'Submission', 'Review', 'Copyediting', and 'Production'. The 'Title' section contains a text box with the following text:

Title
Odd Harmonious Labeling of the Zinnia Flower Graphs

The 'Subtitle' section contains an empty text box.

The 'Abstract' section contains a text box with the following text:

Abstract
An odd harmonious graph is a graph that satisfies the properties of odd harmonious labeling. In this study a new graph class construction is given, namely zinnia flower graphs and variations of the zinnia flower graphs. The research method used is qualitative and includes several stages, namely data collection, data processing and analysis, and verification of the results. The purpose of this research is to prove that the zinnia flower graph and its variations satisfy odd harmonious labeling properties. The result of this research is that the zinnia flower graph and its variations are odd harmonious graphs.

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TUMBUH BERSAMA MERAIH x LLDIKTI Wilayah VI x (2056) Alfina Nindiyani fi x WhatsApp x FKP Firmansah et al. | Odd Harm...

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Status: **Unscheduled**

Title & Abstract

Contributors

Metadata

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List of Contributors

Name	E-mail	Role	Primary Contact	In Browse Lists
Fery Firmansah	firmsahmath@gmail.com	Author	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Tasari	tasarialine@gmail.com	Author	<input type="checkbox"/>	<input checked="" type="checkbox"/>

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Abdel-Aal, M. E. (2013). Odd Harmonious Labelings of Cyclic Snakes. *International Journal on Applications of Graph Theory In Wireless Ad Hoc Networks And Sensor Networks*, 5(3). <https://doi.org/10.5121/jgraphoc.2013.5301>

Abdel-Aal, & Secoud. (2016). Further Results on Odd Harmonious Graphs. *International Journal on Applications of Graph Theory In Wireless Ad Hoc Networks And Sensor Networks*, 8(3/4). <https://doi.org/10.5121/jgraphoc.2016.8401>

Febriana, F., & Sugeng, K. A. (2020). Odd harmonious labeling on squid graph and double squid graph. *Journal of Physics: Conference Series*, 1538(1). <https://doi.org/10.1088/1742-6596/1538/1/012015>

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Review Artikel oleh Reviewer A dan Reviewer B (7 Maret 2023)

JURNAL ILMIAH SAINS

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e-ISSN 2540-9840 p-ISSN 1412-3770 **Jurnal Ilmiah Sains**, Month Year, vol(iss): page.
 Accredited by Ministry of Education, Culture, Research and Technology No: 105/E/KP/2022 DOI: <https://doi.org/10.35799/jis.DOI.Number> Available online at <https://ejournal.unsrat.ac.id/index.php/jis>

Formulir Penilaian Artikel Jurnal Ilmiah Sains (JIS)

(diisi oleh Editor):

Tanggal	7 Maret 2023
No.	
Judul Artikel	Odd Harmonious Labeling of the Zinnia Flower Graphs
Kode Reviewer	

Mohon berikan centang (✓) pada kolom skor penilaian dan uraikan pendapat Bapak/Ibu dalam kolom komentar:

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Relevansi	Kesesuaian topik artikel dengan cakupan jurnal					✓
Komentar:						
Kontribusi	Kualitas artikel ditinjau dari ide/gagasan dan keaslian (originality), kebaruan (novelty), dan keunikan					✓
Komentar:						

Page 1 of 9 | 1999 words | Indonesian | Accessibility: Investigate | 33°C Cerah | 16:32 20/08/2024

Pendahuluan	<ul style="list-style-type: none"> Kejelasan pengungkapan <i>background of problem</i> atau permasalahan, ruang lingkup, dan tujuan penelitian, perbedaan dengan penelitian sebelumnya, kontribusi yang akan diberikan 							<input checked="" type="checkbox"/>
<p>Komentar: Perlu ditambahkan perbedaan dengan penelitian sebelumnya dan apa keunikan dari penelitian ini dibandingkan penelitian-penelitian sebelumnya.</p>								
Metode Penelitian	<ul style="list-style-type: none"> Kedalaman akademis, Kesesuaian dan ketepatan pertanyaan dan metodologi penelitian 							<input checked="" type="checkbox"/>
<p>Komentar: Penekanan data collection pada <i>Zinnia Flower Graphs</i></p>								
Hasil dan Pembahasan	<ul style="list-style-type: none"> Penyajian hasil dan ketajaman analisis (dapat disertai Tabel dan Gambar untuk memudahkan pemahaman) Adanya kaitan antara hasil yang diperoleh dengan konsep dasar dan/atau hipotesis Implikasi hasil penelitian, baik teoritis maupun penerapan 							<input checked="" type="checkbox"/>
<p>Komentar:</p>								

Page 2 of 9 | 1999 words | Indonesian | Accessibility: Investigate | 33°C Cerah | 16:33 20/08/2024

	<ul style="list-style-type: none"> penyajianny Penalaran penulis secara logis dan jujur berdasarkan fakta yang diperoleh 							<input checked="" type="checkbox"/>								
<p>Komentar: Perbaiki kalimat pada kesimpulan untuk menekankan bahwa <i>Odd Harmonious Labeling</i> pada konstruksi graf yang baru (<i>Zinnia flowers</i> dan variasinya) merupakan tujuan utama dari penelitian ini.</p>																
Daftar Pustaka	<ul style="list-style-type: none"> Tata cara penulisan dan perujukan/pengutipan pada naskah (semua referensi harus dirujuk pada naskah), Ketepatan dan kelengkapan referensi Kualitas dan kemitakhiran pustaka Penulisan daftar pustaka menggunakan software mendeley atau sejenisnya? 							<input checked="" type="checkbox"/>								
<p>Komentar:</p> <p>Mohon dituliskan ulasan lain yang belum terakup di atas.</p> <ol style="list-style-type: none"> Menunjukkan gambar sebaiknya tidak menggunakan kata "<i>as follows</i>", tapi langsung mencantumkan nomor gambar. Pada beberapa bagian perlu diperhatikan penghubung antar kalimat agar pembaca bisa dengan mudah mengikuti penjelasan. 																
<p>Rekomendasi untuk JIS (ketikkan tanda ✓ di sebelah kiri pilihan rekomendasi)</p> <table border="1"> <tr> <td><input type="checkbox"/></td> <td>Naskah dapat diterima dan dimuat tanpa perubahan</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Naskah dapat diterima dengan revisi minor</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Naskah dapat diterima dengan revisi mayor</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Naskah ditolak (tidak dapat dimuat)</td> </tr> </table>									<input type="checkbox"/>	Naskah dapat diterima dan dimuat tanpa perubahan	<input checked="" type="checkbox"/>	Naskah dapat diterima dengan revisi minor	<input type="checkbox"/>	Naskah dapat diterima dengan revisi mayor	<input type="checkbox"/>	Naskah ditolak (tidak dapat dimuat)
<input type="checkbox"/>	Naskah dapat diterima dan dimuat tanpa perubahan															
<input checked="" type="checkbox"/>	Naskah dapat diterima dengan revisi minor															
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e-ISSN 2540-9840 p-ISSN 1412-3770 **Jurnal Ilmiah** Sains, Month Year, vol(issue) page.
 Accredited by Ministry of Education, Culture, Research and Technology No: 105/E/KP/2022 DOI: <https://doi.org/10.35799/jis> DOI Number Available online at <https://ejournal.unsrat.ac.id/index.php/jis>

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Relevansi	Kesesuaian topik artikel dengan cakupan jurnal					✓
Komentar:						
Kontribusi	Kualitas artikel ditinjau dari ide/gagasan dan keaslian (<i>originality</i>), kebaruan (<i>novelty</i>), dan keunikan					✓
Komentar:						

Page 2 of 9 2000 words English (United Kingdom) Accessibility: Investigate 16:33 20/08/2024

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Komentar:

- There is a misspelling name. *Abdel All* and *Sqoud* should be *Abdel-Aal* and *Sqoud*. (Line 1 of Paragraph 2 in introduction).
- There is no consistency of the use of *et al*. Some references with 3 names use *et al*, some are not.
- No year in quoting *Saraswati*. (Line 8 in paragraph 2 of Introduction)

Mohon dituliskan ulasan lain yang belum tercakup di atas.
 Please state the benefits of this result or, in general, the odd harmonious labeling.

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Saran Untuk Editor:

Page 2 of 9 2000 words Indonesian Accessibility: Investigate 16:34 20/08/2024

Publikasi Artikel (31 April 2023)

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Jurnal Ilmiah Sains
E-ISSN: 2540-9840 P-ISSN: 1412-3770

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Odd Harmonious Labeling of the Zinnia Flower Graphs

Fery Firmansah
Department of Mathematics Education, Widya Dharma University, Klaten, Indonesia

Tasari Tasari
Department of Mathematics Education, Widya Dharma University, Klaten, Indonesia

Muhammad Ridlo Yuwono
Department of Mathematics Education, Widya Dharma University, Klaten, Indonesia

ADDITIONAL MENU

- Focus and Scope
- Reviewers
- Editorial Team
- Peer Review Process
- Publication Ethics
- Open Access Policy
- Author Publication Charge
- Instructions For Authors
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- Copyright Notice & Licences
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This screenshot shows the main content of the article page. The left column contains the abstract and keywords. The middle column features a "More Citation Formats" dropdown, the issue information ("Volume 23 Nomor 1, April 2023"), the section "Articles", and the license information. The right sidebar displays a citation count of 3528, a "Journal Template" download button, and a "Visitors" section with a bar chart showing visitor counts from various countries.

harmonious labeling properties. The result of this research is that the zinnia flower graph and its variations are odd harmonious graphs.

Keywords: Flower graph; odd harmonious graph; odd harmonious labelling; zinnia flower graph

Pelabelan Harmonis Ganjil dari Graf Bunga Zinnia

ABSTRAK

Graf yang memiliki sifat pelabelan harmonis ganjil adalah graf harmonis ganjil. Pada penelitian ini akan didapatkan konstruksi graf bunga zinnia dan variasi graf bunga zinnia. Metode penelitian yang digunakan adalah penelitian kualitatif yang terdiri beberapa tahapan yaitu pengumpulan data, pengolahan dan analisis data, serta verifikasi hasil. Tujuan penelitian ini adalah menemukan kelas graf baru yang merupakan keluarga dari graf harmonis ganjil. Hasil penelitian ini diperoleh bahwa graf bunga zinnia dan variasi graf bunga zinnia merupakan graf harmonis ganjil.

Kata kunci: Graf bunga; graf bunga zinnia; graf harmonis ganjil; pelabelan harmonis ganjil

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US	1,212	CZ	120
SG	753	TR	81

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Relevansi	Kesesuaian topik artikel dengan cakupan jurnal					√
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<i>Komentar:</i> Penekanan <i>data collection</i> pada <i>Zinnia Flower Graphs</i>									
Hasil dan Pembahasan	<ul style="list-style-type: none"> • Penyajian hasil dan ketajaman analisis (dapat disertai Tabel dan Gambar untuk memudahkan pemahaman) • Adanya kaitan antara hasil yang diperoleh dengan konsep dasar dan/atau hipotesis • Implikasi hasil penelitian, baik teoritis maupun penerapan 								√
<i>Komentar:</i>									
Kesimpulan	<ul style="list-style-type: none"> • Esensi temuan dari penelitian yang dilakukan dan penyajiannya • Penalaran penulis secara logis dan jujur berdasarkan fakta yang diperoleh 								√
<i>Komentar:</i> Perbaiki kalimat pada kesimpulan untuk menekankan bahwa <i>Odd Harmonious Labeling</i> pada konstruksi graf yang baru (<i>Zinnia flowers</i> dan variasinya) merupakan tujuan utama dari penelitian ini.									
Daftar Pustaka	<ul style="list-style-type: none"> • Tata cara penulisan dan perujukan/pengutipan pada naskah (semua referensi harus dirujuk pada naskah), • Ketepatan dan kelengkapan referensi • Kualitas dan kemutakhiran pustaka • Penulisan daftar pustaka menggunakan software mendeley atau sejenisnya? 								√
<i>Komentar:</i>									

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Odd Harmonious Labeling of the Zinnia Flower Graphs

ABSTRACT

An odd harmonious graph is a graph that satisfies the properties of odd harmonious labeling. In this study a new graph class construction is given, namely zinnia flower graphs and variations of the zinnia flower graphs. The research method used is qualitative and includes several stages, namely data collection, data processing and analysis, and verification of the results. The purpose of this research is to prove that the zinnia flower graph and its variations satisfy odd harmonious labeling properties. The result of this research is that the zinnia flower graph and its variations are odd harmonious graphs.

Keywords: flower graph, odd harmonious graph, odd harmonious labeling, zinnia flower graph

INTRODUCTION

The topic of research on graph labeling has grown tremendously in recent years, as evidenced by the various types of research results on graph labeling (Gallian, 2022). One of the research topics on graph labeling is odd harmonious graph labeling. Liang and Bai introduced odd harmonious graphs in 2009. Graph $G(p, q)$ with order $p = |V(G)|$ and size $q = |E(G)|$ is an odd harmonious graph if it satisfies an injective vertex labeling function $g: V(G) \rightarrow \{0, 1, 2, 3, 4, \dots, 2q - 1\}$ such that it induces a bijective edge labeling function $g^*: E(G) \rightarrow \{1, 3, 5, 7, 9, \dots, 2q - 1\}$ with $g^*(mn) = g(m) + g(n)$ (Liang & Bai, 2009). In the same paper, Liang and Bai proved that cycle graphs, complete graphs, bipartite graphs, and windmill graphs are odd harmonious graphs.

In a different paper, Abdel All and Seoud (2016) also found a class of odd harmonious graphs (Abdel-Aal & Seoud, 2016). Jeyanti et al in 2015 also found several classes of odd harmonious graphs (Jeyanthi et al., 2015). Other relevant research results are as follows (Abdel-Aal, 2013), (Firmansah & Yuwono, 2017a), (Firmansah, 2017), (Firmansah & Yuwono, 2017b), (Seoud & Hafez, 2018), (Jeyanthi, Philo, & Siddiqui, 2019), (Sugeng et al., 2019), (Jeyanthi, Philo, & Youssef, 2019), and (Jeyanthi & Philo, 2019).

In 2020 Febriana and Sugeng proved that odd harmonious labeling on squid graphs (Febriana & Sugeng, 2020). Sarasvati et al proved that edge combination product are odd harmonious graphs. Firmansah proved that multiple net snake graphs are odd harmonious graphs (Firmansah, 2020b). In a different paper, results of other relevant research in 2020, 2021 and 2022 are as follows (Firmansah, 2020a), (Firmansah & Tasari, 2020), (Firmansah & Giyarti, 2021), (Philo & Jeyanthi, 2021), and (Firmansah, 2022).

In this paper, we will construct the definition of the zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$. Furthermore, it will be proved that zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph

$Z_v(h)$ with $h \geq 1$ satisfy the properties of odd harmonic labeling. As a result, it is obtained that the zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ are odd harmonious graphs.

RESEARCH METHOD

The research in this paper is of the qualitative research type. The research stages consist of data collection, data processing and analysis, and verification of results. The data collection stage consists of collecting the latest research results on new graph construction, odd harmonious labeling, and odd harmonious graphs. The data processing and analysis stage consists of constructing definitions and properties of new graphs. The result verification stage is in the form of making theorems about odd harmonious graphs with mathematical proof.

RESULTS AND DISCUSSION

This research results in constructing the definition of the zinnia flower graphs and their variations in Definition 1 and Definition 2.

Definition 1. Zinnia flower graph $Z(h)$ with $h \geq 1$ is a graph with vertex set $V(Z(h)) = \{a_j | 1 \leq j \leq 2h + 2\} \cup \{b_i | i = 1, 2\} \cup \{c_j^i | 1 \leq j \leq h, i = 1, 2\}$ and edge set $E(Z(h)) = \{a_j b_i | 1 \leq j \leq 2h + 2, i = 1, 2\} \cup \{a_1 c_j^i | 1 \leq j \leq h, i = 1, 2\} \cup \{a_2 c_j^i | 1 \leq j \leq h, i = 1, 2\}$.

Based on Definition 1, $p = |V(Z(h))| = 4h + 4$ and $q = |E(Z(h))| = 8h + 4$ are obtained and the figure construction of the zinnia flower graph $Z(h)$ is obtained as follows

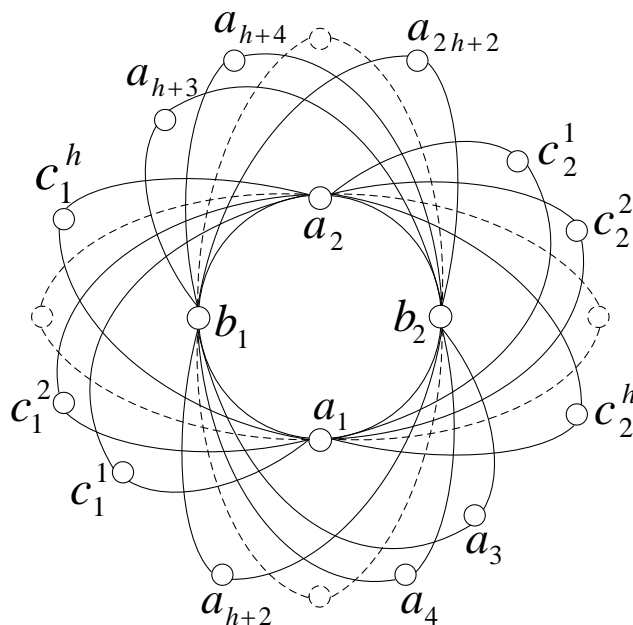


Figure 1. Zinnia flower graph $Z(h)$

Definition 2. Variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is a graph with vertex set $V(Z_v(h)) = \{u_0\} \cup \{v_j^i | i, j = 1, 2\} \cup \{w_j | 1 \leq j \leq h\} \cup \{x_j | 1 \leq j \leq h\} \cup$

$\{y_j | 1 \leq j \leq h\} \cup \{z_j | 1 \leq j \leq h\}$ and edge set $E(Z_v(h)) = \{u_0 v_j^i | i, j = 1, 2\} \cup \{v_1^2 w_j | 1 \leq j \leq h\} \cup \{v_2^2 w_j | 1 \leq j \leq h\} \cup \{v_2^2 x_j | 1 \leq j \leq h\} \cup \{v_2^1 x_j | 1 \leq j \leq h\} \cup \{v_2^1 y_j | 1 \leq j \leq h\} \cup \{v_1^1 y_j | 1 \leq j \leq h\} \cup \{v_1^1 z_j | 1 \leq j \leq h\} \cup \{v_1^2 z_j | 1 \leq j \leq h\}$.

Based on Definition 2, $p = |V(Z_v(h))| = 4h + 5$ and $q = |E(Z_v(h))| = 8h + 4$ are obtained and the figure construction variations of the zinnia flower graph $Z_v(h)$ is obtained as follows

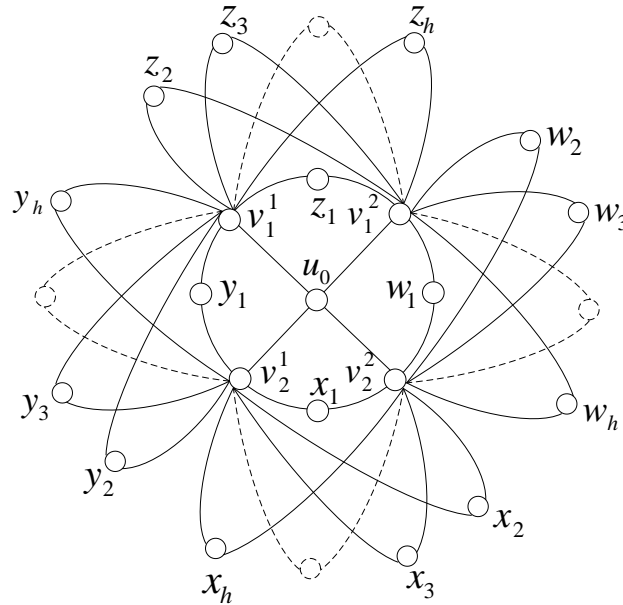


Figure 2. Variations of the zinnia flower graph $Z_v(h)$

Furthermore, it is proven that the zinnia flower graphs and their variations satisfy the properties of the odd harmonious labeling function stated in Theorem 3 and Theorem 4.

Theorem 3. Zinnia flower graph $Z(h)$ with $h \geq 1$ is an odd harmonious graph.

Proof.

Define the vertex labeling function $g: V(Z(h)) \rightarrow \{0, 1, 2, 3, \dots, 16h + 7\}$ as follows

$$g(a_j) = 4j - 4, 1 \leq j \leq 2h + 2 \tag{1}$$

$$g(b_i) = 2i - 1, i = 1, 2 \tag{2}$$

$$g(c_j^i) = 8h + 8j + 2i - 1, 1 \leq j \leq h, i = 1, 2 \tag{3}$$

Based on (1), (2) and (3), different labels are obtained and $V(Z(h)) \subseteq \{0, 1, 2, 3, \dots, 16h + 7\}$, hence the vertex labeling function is injective.

Define the edge labeling function $g^*: E(Z(h)) \rightarrow \{1, 3, 5, 7, \dots, 16h + 7\}$ as follows

$$g^*(a_j b_i) = 4j + 2i - 5, 1 \leq j \leq 2h + 2, i = 1, 2 \tag{4}$$

$$g^*(a_1 c_j^i) = 8h + 8j + 2i - 1, 1 \leq j \leq h, i = 1, 2 \tag{5}$$

$$g^*(a_2 c_j^i) = 8h + 8j + 2i + 3, 1 \leq j \leq h, i = 1, 2 \tag{6}$$

Based on (4), (5) and (6), different labels are obtained and $E(Z(h)) = \{1, 3, 5, 7, \dots, 16h + 7\}$, hence the edge labeling function is bijective. Consequently zinnia flower graph $Z(h)$ with $h \geq 1$ is an odd harmonious graph. ■

The zinnia flower graph $Z(4)$ as follows

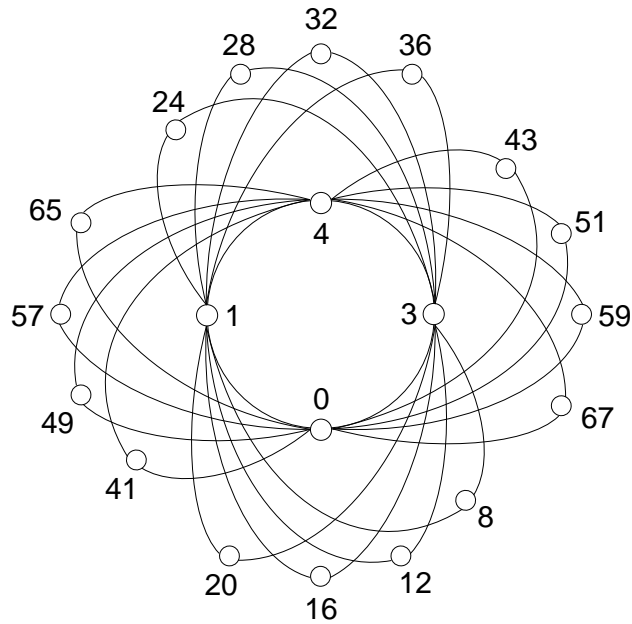


Figure 3. Zinnia flower graph $Z(4)$

Theorem 4. Variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is an odd harmonious graph.

Proof.

Define the vertex labeling function $g: V(Z_v(h)) \rightarrow \{0,1,2,3 \dots, 16h + 7\}$ as follows

$$g(u_0) = 0 \tag{7}$$

$$g(v_j^i) = 4j + 2i - 5, \quad i, j = 1, 2 \tag{8}$$

$$g(w_j) = 16j - 12, \quad 1 \leq j \leq h \tag{9}$$

$$g(x_j) = 16j - 2, \quad 1 \leq j \leq h \tag{10}$$

$$g(y_j) = 16j - 4, \quad 1 \leq j \leq h \tag{11}$$

$$g(z_j) = 16j + 2, \quad 1 \leq j \leq h \tag{12}$$

Based on (7), (8), (9), (10), (11) and (12), different labels are obtained and $V(Z_v(h)) \subseteq \{0,1,2,3 \dots, 16h + 7\}$, hence the vertex labeling function is injective.

Define the edge labeling function $g^*: E(Z_v(h)) \rightarrow \{1,3,5,7, \dots, 16h + 7\}$ as follows

$$g^*(u_0 v_j^i) = 4j + 2i - 5, \quad i, j = 1, 2 \tag{13}$$

$$g^*(v_1^2 w_j) = 16j - 7, \quad 1 \leq j \leq h \tag{14}$$

$$g^*(v_2^2 w_j) = 16j - 5, \quad 1 \leq j \leq h \tag{15}$$

$$g^*(v_2^2 x_j) = 16j + 5, \quad 1 \leq j \leq h \tag{16}$$

$$g^*(v_2^1 x_j) = 16j + 1, \quad 1 \leq j \leq h \tag{17}$$

$$g^*(v_2^1 y_j) = 16j - 1, \quad 1 \leq j \leq h \tag{18}$$

$$g^*(v_1^1 y_j) = 16j - 3, \quad 1 \leq j \leq h \tag{19}$$

$$g^*(v_1^1 z_j) = 16j + 3, \quad 1 \leq j \leq h \tag{20}$$

$$g^*(v_1^1 z_j) = 16j + 7, \quad 1 \leq j \leq h \tag{21}$$

Based on (13), (14), (15), (16), (17), (18), (19), (20) and (21), different labels are obtained and $E(Z_v(h)) = \{1,3,5,7, \dots, 16h + 7\}$, hence the edge labeling function is bijective. Consequently variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is an odd harmonious graph. ■

Variations of the zinnia flower graph $Z(5)$ as follows

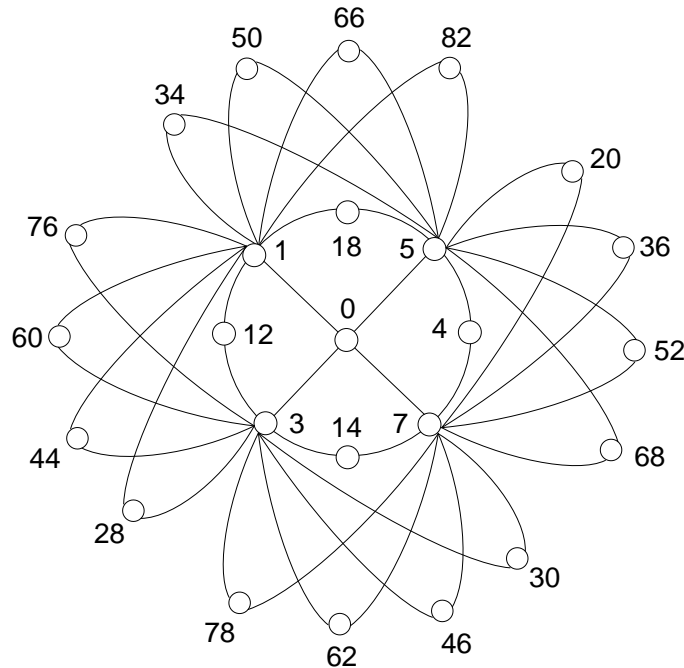


Figure 4. Variations of the zinnia flower graph $Z_v(5)$

Based on Theorem 3 and Theorem 4, it has been obtained that $Z(h)$ with $h \geq 1$ in Definition 1 and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ are odd harmonious labeling.

CONCLUSION

The conclusion of this research is the definition of the zinnia flower graph $Z(h)$ with $h \geq 1$ in Definition 1 and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ in Definition 2. In addition, the two new classes of graphs have been shown to satisfy the properties of odd harmonious graphs. Theorem 3 for the proof of the zinnia flower graph and Theorem 4 for the proof of the zinnia flower graph variation.

For further research, this study can be continued by looking for the construction of new graph class definitions that are the development of the zinnia flower graph and proving that these graphs are also odd harmonious graphs.

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Formulir Penilaian Artikel Jurnal Ilmiah Sains (JIS)

(diisi oleh Editor):

Tanggal	7 Maret 2023
No.	
Judul Artikel	
Kode Reviewer	

Mohon berikan centang (√) pada kolom skor penilaian dan uraikan pendapat Bapak/Ibu dalam kolom komentar:

Variabel Penilaian	Deskripsi	Skor Penilaian (0 = buruk 4 = baik sekali)				
		0	1	2	3	4
Relevansi	Kesesuaian topik artikel dengan cakupan jurnal					√
Komentar:						
Kontribusi	Kualitas artikel ditinjau dari ide/gagasan dan keaslian (<i>originality</i>), kebaruan (<i>novelty</i>), dan keunikan					√
Komentar:						
Organisasi Artikel	Bahasa yang digunakan, kejelasan isi artikel, dan kemudahan dipahami oleh pembaca					√
Komentar:						
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		0	1	2	3	4
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Komentar:						
Abstrak (dua bahasa: Inggris dan Indonesia)	<ul style="list-style-type: none"> menarik perhatian dan mendorong pembaca meluangkan waktu untuk mendapatkan dan membaca <i>full paper</i> Singkat, jelas dan lengkap menerangkan tujuan dan ruang lingkup penelitian, metode yang digunakan, ringkasan hasil, dan kesimpulan 					√ √
Komentar:						
Pendahuluan	<ul style="list-style-type: none"> Kejelasan pengungkapan <i>background of problem</i> atau permasalahan, ruang lingkup, dan tujuan penelitian, perbedaan dengan penelitian sebelumnya, kontribusi yang akan diberikan 					√ √ √
Komentar:						

Metode Penelitian	<ul style="list-style-type: none"> • Kedalaman akademis, • Kesesuaian dan ketepatan pertanyaan dan metodologi penelitian 					√	√
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Hasil dan Pembahasan	<ul style="list-style-type: none"> • Penyajian hasil dan ketajaman analisis (dapat disertai Tabel dan Gambar untuk memudahkan pemahaman) • Adanya kaitan antara hasil yang diperoleh dengan konsep dasar dan/atau hipotesis • Implikasi hasil penelitian, baik teoritis maupun penerapan 					√	√
<i>Komentar:</i>							
Kesimpulan	<ul style="list-style-type: none"> • Esensi temuan dari penelitian yang dilakukan dan penyajiannya • Penalaran penulis secara logis dan jujur berdasarkan fakta yang diperoleh 					√	√
<i>Komentar:</i>							
Daftar Pustaka	<ul style="list-style-type: none"> • Tata cara penulisan dan perujukan/pengutipan pada naskah (semua referensi harus dirujuk pada naskah), • Ketepatan dan kelengkapan referensi • Kualitas dan kemutakhiran pustaka • Penulisan daftar pustaka menggunakan software mendeley atau sejenisnya? 					√	√
<i>Komentar:</i>							
<ul style="list-style-type: none"> • <i>There is a misspelling name. Abdel All and Seoud should be Abdel-Aal and Seoud (Line 1 of Paragraph 2 in Introduction).</i> • <i>There is no consistency of the use of et al. Some references with 3 names use et al, some are not.</i> • <i>No year in quoting Sarasvati (Line 8 in paragraph 2 of Introduction)</i> 							

Mohon dituliskan ulasan lain yang belum tercakup di atas.

Please state the benefits of this result or, in general, the odd harmonious labeling.

Rekomendasi untuk JIS (ketikkan tanda √ di sebelah kiri pilihan rekomendasi)

	Naskah dapat diterima dan dimuat tanpa perubahan
√	Naskah dapat diterima dengan revisi minor
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Saran Untuk Penulis	<i>Just correct and add the items as suggested.</i>
Saran Untuk Editor	

Odd Harmonious Labeling of the Zinnia Flower Graphs

ABSTRACT

An odd harmonious graph is a graph that satisfies the properties of odd harmonious labeling. In this study a new graph class construction is given, namely zinnia flower graphs and variations of the zinnia flower graphs. The research method used is qualitative and includes several stages, namely data collection, data processing and analysis, and verification of the results. The purpose of this research is to prove that the zinnia flower graph and its variations satisfy odd harmonious labeling properties. The result of this research is that the zinnia flower graph and its variations are odd harmonious graphs.

Keywords: flower graph, odd harmonious graph, odd harmonious labeling, zinnia flower graph

INTRODUCTION

The topic of research on graph labeling has grown tremendously in recent years, as evidenced by the various types of research results on graph labeling (Gallian, 2022). One of the research topics on graph labeling is odd harmonious graph labeling. Liang and Bai introduced odd harmonious graphs in 2009. Graph $G(p, q)$ with order $p = |V(G)|$ and size $q = |E(G)|$ is an odd harmonious graph if it satisfies an injective vertex labeling function $g: V(G) \rightarrow \{0, 1, 2, 3, 4, \dots, 2q - 1\}$ such that it induces a bijective edge labeling function $g^*: E(G) \rightarrow \{1, 3, 5, 7, 9, \dots, 2q - 1\}$ with $g^*(mn) = g(m) + g(n)$ (Liang & Bai, 2009). In the same paper, Liang and Bai proved that cycle graphs, complete graphs, bipartite graphs, and windmill graphs are odd harmonious graphs.

In a different paper, Abdel All and Seoud (2016) also found a class of odd harmonious graphs (Abdel-Aal & Seoud, 2016). Jeyanti et al in 2015 also found several classes of odd harmonious graphs (Jeyanthi et al., 2015). Other relevant research results are as follows (Abdel-Aal, 2013), (Firmansah & Yuwono, 2017a), (Firmansah, 2017), (Firmansah & Yuwono, 2017b), (Seoud & Hafez, 2018), (Jeyanthi, Philo, & Siddiqui, 2019), (Sugeng et al., 2019), (Jeyanthi, Philo, & Youssef, 2019), and (Jeyanthi & Philo, 2019).

In 2020 Febriana and Sugeng proved that odd harmonious labeling on squid graphs (Febriana & Sugeng, 2020). Sarasvati et al proved that edge combination product are odd harmonious graphs. Firmansah proved that multiple net snake graphs are odd harmonious graphs (Firmansah, 2020b). In a different paper, results of other relevant research in 2020, 2021 and 2022 are as follows (Firmansah, 2020a), (Firmansah & Tasari, 2020), (Firmansah & Giyarti, 2021), (Philo & Jeyanthi, 2021), and (Firmansah, 2022).

In this paper, we will construct the definition of the zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$. Furthermore, it will be proved that zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ satisfy the properties of odd harmonic labeling. As a result, it is obtained that the zinnia flower graph $Z(h)$ with $h \geq 1$ and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ are odd harmonious graphs.

RESEARCH METHOD

The research in this paper is of the qualitative research type. The research stages consist of data collection, data processing and analysis, and verification of results. The data collection stage consists of collecting the latest research results on new graph construction, odd harmonious labeling, and odd harmonious graphs. The data processing and analysis stage consists of constructing definitions and properties of new graphs. The result verification stage is in the form of making theorems about odd harmonious graphs with mathematical proof.

RESULTS AND DISCUSSION

This research results in constructing the definition of the zinnia flower graphs and their variations in Definition 1 and Definition 2.

Definition 1. Zinnia flower graph $Z(h)$ with $h \geq 1$ is a graph with vertex set $V(Z(h)) = \{a_j | 1 \leq j \leq 2h + 2\} \cup \{b_i | i = 1, 2\} \cup \{c_j^i | 1 \leq j \leq h, i = 1, 2\}$ and edge set $E(Z(h)) = \{a_j b_i | 1 \leq j \leq 2h + 2, i = 1, 2\} \cup \{a_1 c_j^i | 1 \leq j \leq h, i = 1, 2\} \cup \{a_2 c_j^i | 1 \leq j \leq h, i = 1, 2\}$.

Based on Definition 1, $p = |V(Z(h))| = 4h + 4$ and $q = |E(Z(h))| = 8h + 4$ are obtained and the figure construction of the zinnia flower graph $Z(h)$ is obtained as follows

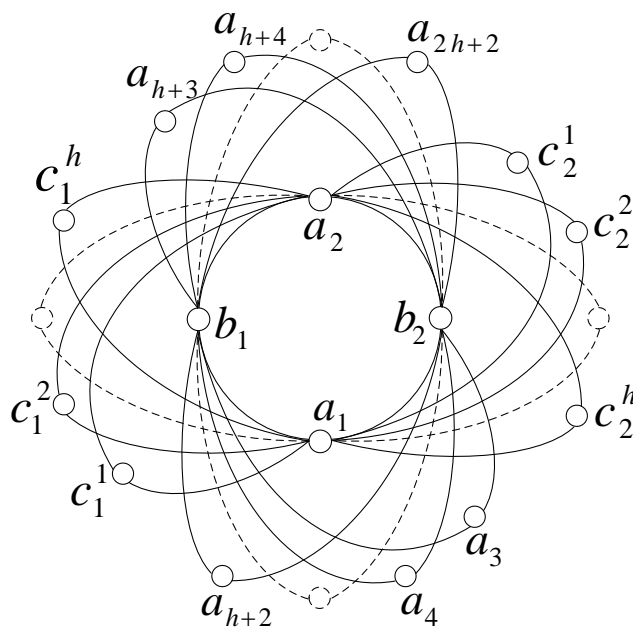


Figure 1. Zinnia flower graph $Z(h)$

Definition 2. Variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is a graph with vertex set $V(Z_v(h)) = \{u_0\} \cup \{v_j^i | i, j = 1, 2\} \cup \{w_j | 1 \leq j \leq h\} \cup \{x_j | 1 \leq j \leq h\} \cup \{y_j | 1 \leq j \leq h\} \cup \{z_j | 1 \leq j \leq h\}$ and edge set $E(Z_v(h)) = \{u_0 v_j^i | i, j = 1, 2\} \cup \{v_1^2 w_j | 1 \leq j \leq h\} \cup \{v_2^2 w_j | 1 \leq j \leq h\} \cup \{v_2^2 x_j | 1 \leq j \leq h\} \cup \{v_2^1 x_j | 1 \leq j \leq h\} \cup \{v_2^1 y_j | 1 \leq j \leq h\} \cup \{v_1^1 y_j | 1 \leq j \leq h\} \cup \{v_1^1 z_j | 1 \leq j \leq h\} \cup \{v_1^2 z_j | 1 \leq j \leq h\}$.

Based on Definition 2, $p = |V(Z_v(h))| = 4h + 5$ and $q = |E(Z_v(h))| = 8h + 4$ are obtained and the figure construction variations of the zinnia flower graph $Z_v(h)$ is obtained as follows

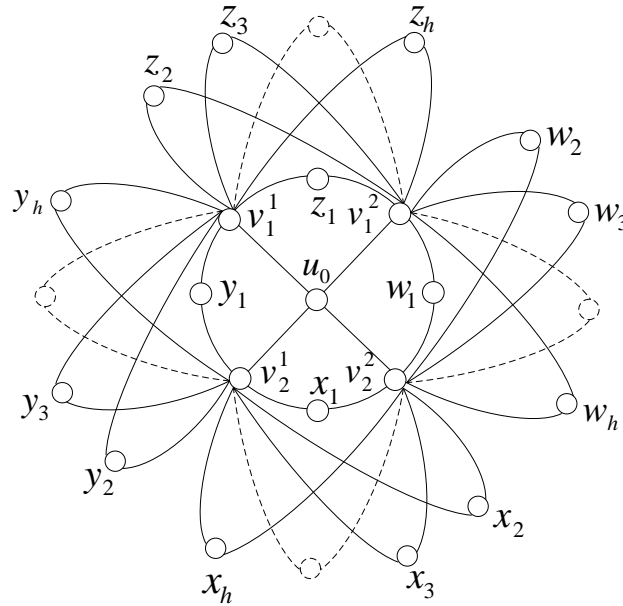


Figure 2. Variations of the zinnia flower graph $Z_v(h)$

Furthermore, it is proven that the zinnia flower graphs and their variations satisfy the properties of the odd harmonious labeling function stated in Theorem 3 and Theorem 4.

Theorem 3. Zinnia flower graph $Z(h)$ with $h \geq 1$ is an odd harmonious graph.

Proof.

Define the vertex labeling function $g: V(Z(h)) \rightarrow \{0,1,2,3 \dots, 16h + 7\}$ as follows

$$g(a_j) = 4j - 4, 1 \leq j \leq 2h + 2 \tag{1}$$

$$g(b_i) = 2i - 1, i = 1,2 \tag{2}$$

$$g(c_j^i) = 8h + 8j + 2i - 1, 1 \leq j \leq h, i = 1,2 \tag{3}$$

Based on (1), (2) and (3), different labels are obtained and $V(Z(h)) \subseteq \{0,1,2,3 \dots, 16h + 7\}$, hence the vertex labeling function is injective.

Define the edge labeling function $g^*: E(Z(h)) \rightarrow \{1,3,5,7, \dots, 16h + 7\}$ as follows

$$g^*(a_j b_i) = 4j + 2i - 5, 1 \leq j \leq 2h + 2, i = 1,2 \tag{4}$$

$$g^*(a_1 c_j^i) = 8h + 8j + 2i - 1, 1 \leq j \leq h, i = 1,2 \tag{5}$$

$$g^*(a_2 c_j^i) = 8h + 8j + 2i + 3, 1 \leq j \leq h, i = 1,2 \tag{6}$$

Based on (4), (5) and (6), different labels are obtained and $E(Z(h)) = \{1,3,5,7, \dots, 16h + 7\}$, hence the edge labeling function is bijective. Consequently zinnia flower graph $Z(h)$ with $h \geq 1$ is an odd harmonious graph. ■

The zinnia flower graph $Z(4)$ as follows

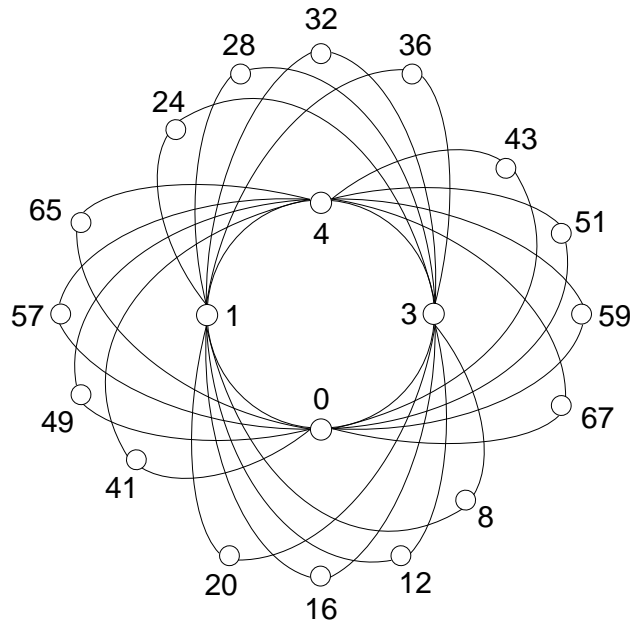


Figure 3. Zinnia flower graph $Z(4)$

Theorem 4. Variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is an odd harmonious graph.

Proof.

Define the vertex labeling function $g: V(Z_v(h)) \rightarrow \{0,1,2,3 \dots,16h + 7\}$ as follows

$$g(u_0) = 0 \tag{7}$$

$$g(v_j^i) = 4j + 2i - 5, \quad i, j = 1,2 \tag{8}$$

$$g(w_j) = 16j - 12, \quad 1 \leq j \leq h \tag{9}$$

$$g(x_j) = 16j - 2, \quad 1 \leq j \leq h \tag{10}$$

$$g(y_j) = 16j - 4, \quad 1 \leq j \leq h \tag{11}$$

$$g(z_j) = 16j + 2, \quad 1 \leq j \leq h \tag{12}$$

Based on (7), (8), (9), (10), (11) and (12), different labels are obtained and $V(Z_v(h)) \subseteq \{0,1,2,3 \dots,16h + 7\}$, hence the vertex labeling function is injective.

Define the edge labeling function $g^*: E(Z_v(h)) \rightarrow \{1,3,5,7, \dots,16h + 7\}$ as follows

$$g^*(u_0 v_j^i) = 4j + 2i - 5, \quad i, j = 1,2 \tag{13}$$

$$g^*(v_1^2 w_j) = 16j - 7, \quad 1 \leq j \leq h \tag{14}$$

$$g^*(v_2^2 w_j) = 16j - 5, \quad 1 \leq j \leq h \tag{15}$$

$$g^*(v_2^2 x_j) = 16j + 5, \quad 1 \leq j \leq h \tag{16}$$

$$g^*(v_2^1 x_j) = 16j + 1, \quad 1 \leq j \leq h \tag{17}$$

$$g^*(v_2^1 y_j) = 16j - 1, \quad 1 \leq j \leq h \tag{18}$$

$$g^*(v_1^1 y_j) = 16j - 3, \quad 1 \leq j \leq h \tag{19}$$

$$g^*(v_1^1 z_j) = 16j + 3, \quad 1 \leq j \leq h \tag{20}$$

$$g^*(v_1^1 z_j) = 16j + 7, 1 \leq j \leq h \tag{21}$$

Based on (13), (14), (15), (16), (17), (18), (19), (20) and (21), different labels are obtained and $E(Z_v(h)) = \{1,3,5,7, \dots, 16h + 7\}$, hence the edge labeling function is bijective. Consequently variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ is an odd harmonious graph. ■

Variations of the zinnia flower graph $Z(5)$ as follows

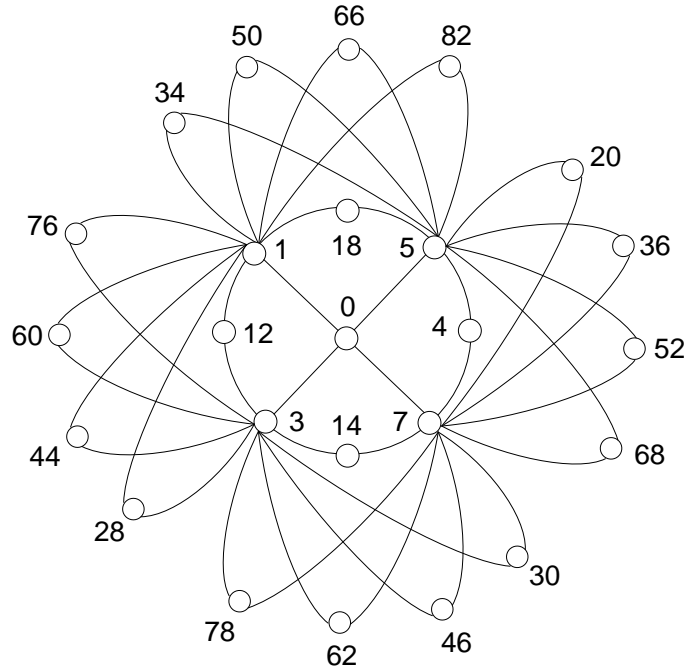


Figure 4. Variations of the zinnia flower graph $Z_v(5)$

Based on Theorem 3 and Theorem 4, it has been obtained that $Z(h)$ with $h \geq 1$ in Definition 1 and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ are odd harmonious labeling.

CONCLUSION

The conclusion of this research is the definition of the zinnia flower graph $Z(h)$ with $h \geq 1$ in Definition 1 and variations of the zinnia flower graph $Z_v(h)$ with $h \geq 1$ in Definition 2. In addition, the two new classes of graphs have been shown to satisfy the properties of odd harmonious graphs. Theorem 3 for the proof of the zinnia flower graph and Theorem 4 for the proof of the zinnia flower graph variation.

For further research, this study can be continued by looking for the construction of new graph class definitions that are the development of the zinnia flower graph and proving that these graphs are also odd harmonious graphs.

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