Analyzing lives information of empty nesters in data visualization method

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Abstract: *This paper analyzes the information of 39,276 empty nesters living in Ziyang city. Using the Neo4j Graph database and data visualization tools, Pyecharts. It takes Ziyang City as a case. By collecting an unstructured dataset containing specific details of 39,276 empty nesters, released by the local Bureau of Civil Affairs. The final result of this paper proves that the practical method is achievable. Besides, the final analysis result could be a trustable reference cited by local government or municipal decision-makers to perfect laws and policies in the local elderly care industry.*

Keywords: Neo4j, pyecharts, data analytics, empty nesters, elderly care

1. Background

Recent research in the aged care industry demonstrates that China's aging population over 60 will spike rapidly in the following decades. The aging population in 2030 is approximately double that of 2015, rising to 400 million. Furthermore, China's aging population will eventually rise to 500 million in 2050[1]. One elderly with no self-care abilities and be less cared for by others is an "empty nester." One prediction is that the number of empty nesters will be up to 20 million people in 2030. The prevalence of chronic diseases, such as hypertension or diabetes, is that nearly half of Chinese older adults suffer from those diseases[2]. As a result, China is facing a horrible reality in the soon future, a large-size group of older adults over 60. All older adults as respondents in this paper are empty nesters.

2. Data visualization method

2.1 Graph Database

A *graph database* is a representative NoSQL database based on Graph theory. The invisible relationship between data could compose a graph structure based on the nodes and relationships in the Neo4j Graph database. Graph database supports creating, reading, updating, and deleting. Neo4j is an open-source graph database based on Java, and it has become widely used since published. Neo4j database supports ACID transactions, including clustering, backup, and failover. The essential data model in the Neo4j database is the node, relationship, and property[3]. The node represents one entity and plays as a solid circle in the Neo4j database. The relationship is to display a connection between nodes, "-" means an undirected line, and "->" means a directed line. The property has the values of nodes or relationships, and it stores them as key-value pairs, e.g., ISBN, name, publisher house, and classification number, all of them are properties of the book.

2.2 Methodology

An enormous amount of relative datasets expressed as graphs or images is known as data visualization. The data item in the dataset presents as a unique graph according to the data visualization theory. As a consequence, one large-scale dataset leads to massive data graphs. Any solution displaying an entity's principle, law, or logic based on graph theory, could have data analysis in the data visualization way. The usual steps to have data visualization are the following:

1)data importing: The source, usage, attribute, and conceptual model of data. Those are mathematical descriptions for visualization objects; 2)data processing: Algorithmic processing in imported data, e.g., cleaning, filtering, dimension reducing, clustering, and more. Besides, to have a mapping between data and visual codings;3) data visualization: To generate visualization production by using appropriate tools and methods, according to the requirements and visualization mechanism[4].

The following steps to have data visualization analysis are: 1)Processing the unstructured dataset and removing invalidation data; 2) Importing the dataset into the Neo4j database, creating nodes or relationships, attaching properties to nodes or relationships; 3)Writing Cypher queries to extract information; 4)Finishing programming Python applications, and those applications run the Cypher queries; 5) Python applications could receive query results and send them to a data visualization tool; 6) Using appropriate tools to have extracted information visualized, and eventually analysis results could be easy to understand.

2.3 Implementation

It creates a graph data model on the Neo4j database based on graph theory. Besides that, utilizing the appropriate Python framework, Pyecharts, to visualize the query results is a straightforward method for learning valuable information. The Pyecharts is an open-source framework based on Echarts, and this tool was developed and designed by a development team. Because of its perfect interactivity and simple API interface, Pyecharts has become a viable tool for data visualization. Py2neo provides the full APIs and functions in operating the Neo4j database, the Python third-party framework, to execute Cypher queries. Py2neo is also a client-end library and development kit. Its primary function is executing Cypher queries in the Python application and command line.

This task operates by finishing writing Cypher queries and sending them to the Python application, and then the application would use Py2neo APIs to execute those Cypher queries. Py2neo calls the Neo4j database to complete the previous step. After getting the query results, the Neo4j database returns the query results to Py2neo. Lastly, Pyecharts gets query results from Py2neo and has those visualized.

3. Graph data model

Table 1: Entities in Neo4j database.

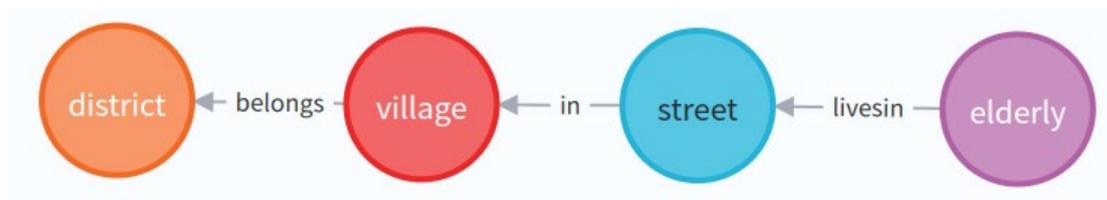| Entity	Num
elderly	39,276
district	4
street	89
village	6,128
(elderly)-[livesin]->(village)	39,262
(village)-[in]->(street)	6,245
(street)-[belongs]->(district)	89
entity sum	45,497
Relationship sum	6,334

Figure 1: Graph data model

As entities shown in Table 1. Creating nodes labeled "elderly" contains a group of properties, age, gender, birth date, marital status, and others. There are also administrative area nodes generated from elderly nodes, such as "Street," "Town," and "District." According to China's administrative division, three types of relationships between administrative area nodes could have links. Indeed the actual graph data model expresses as (:elderly)-[:livesin]-> (:street)-[:in]->(:village)-[:belongs]->(:district). As graph data model shown in Figure 1.

4. Analysis results

4.1 Age

It is obvious to have a comparison in the proportion of various aging groups among 39,276 older

people, focusing on the age of empty nesters. The biggest aging group comprises 69-year-old people, a total of 2,339 older people. The average number of the top 10 aging groups surges to 2,000 people, and the age of older adults in the top 10 aging groups is between 68 and 77. The sum of empty nesters in the top 10 aging groups eventually occupies 60% of 39,276 empty nesters. As results shown in Figure 2.
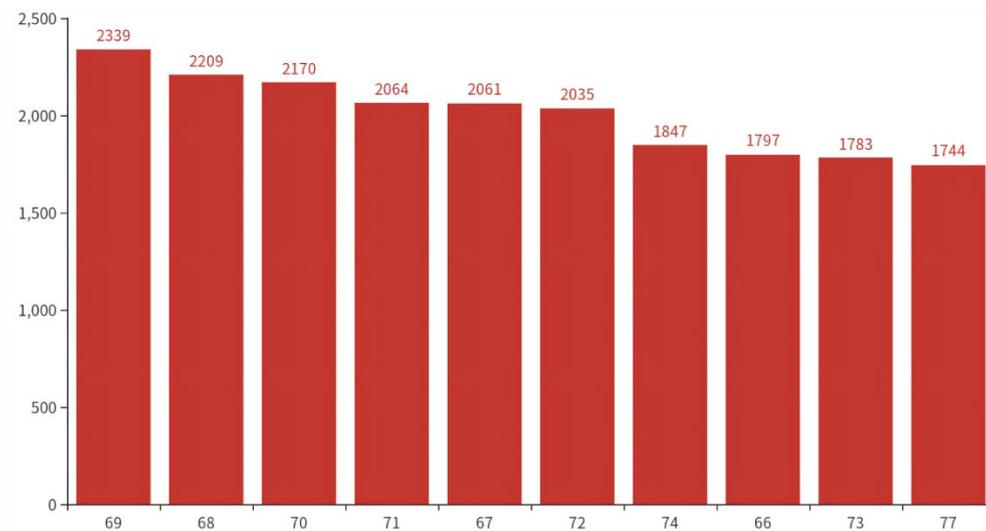

Figure 2: Top 10 aging groups in Ziyang City

4.2 Gender ratio

Paying attention to the male-to-female ratio of these empty nesters reveals that 57% male and 40% female are living in Ziyang City. Still, 3% of the older people are of unknown gender. Consequently, the final gender ratio of empty nesters in Ziyang City is close to 1.41.

In Anyue county, the percentage of men is equivalent to that of women. Surprisingly, the highest gender ratio is in Yanjiang District, which is the highest compared to gender ratios of the other three administrative areas. Anyue County has the lowest one, about 1.19. Anyue County has the most significant number of men and women compared to other administrative regions, with the exact figure of about 9,700 males and 8,100 females. By contrast, Airport Economic District has the smallest group of males and females, nearly 130 and 80.

Approximately 1,430 elderly males whose ages are all 69-year-old, those elderly males gather the largest elderly male group. On the contrary, the total of 70-year-old elderly females is the largest in elderly female groups, and the number is as many as that of 75-year-old elderly males.

By Highlighting the invisible link between the marital status and gender of empty nesters, the query results indicate that more than 12,300 elderly females had been bereft of their spouse. By contrast, about 8,400 elderly males had lost their marital partner. The size of the group of single men is closely 40 times as many as that of single women. Meanwhile, almost 5,000 elderly males and 3,300 elderly females both had married yet.

4.3 Administrative region

The current residential location of empty nesters mainly covers four administrative regions: Anyue County, LeZhi County, Yanjiang District, and Airport Economic District. As four administrative regions shown in Table 2. Thirty-nine thousand two hundred seventy-six empty nesters are living in four administrative regions. The most remarkable finding in the query results is that nearly 50% of empty nesters are now living in Anyue County. It counts 18,397 people. In comparison, there are only 378 older adults in the Airport Economic District and 7,351 in the Yanjiang District. As for Anyue County, its num of streets and villages is similar to sum one of Lezhi County, Yangjiang district, and Airport Economic District. As results shown in Figure 3.

Table 2: Major Administrative regions.

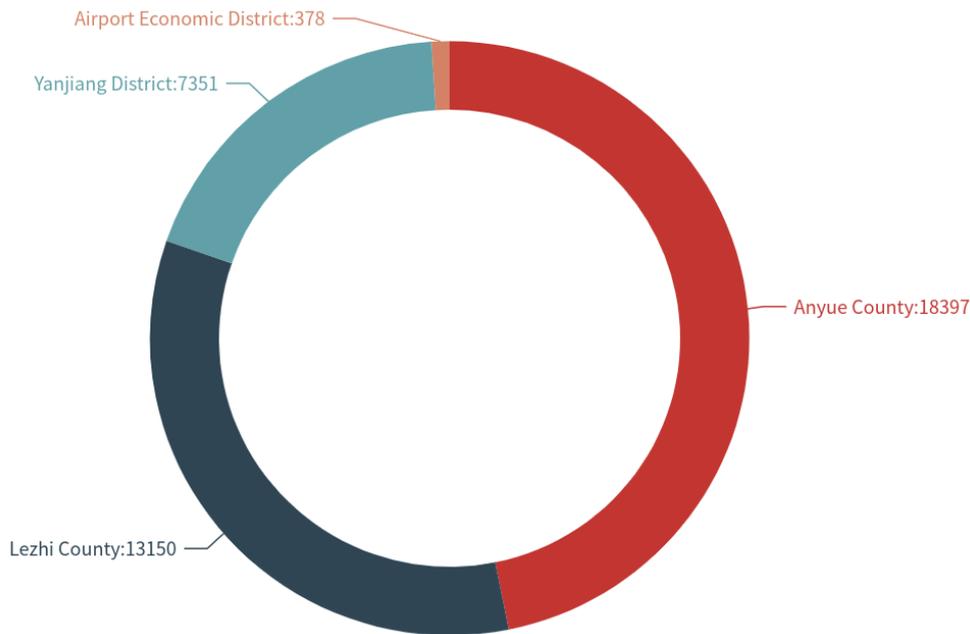| Administrative regions |
| --- |
| Anyue County |
| Lezhi County |
| Yanjiang District |
| Airport Economic District |

Figure 3: Major Administrative regions

According to the number of empty nesters in villages, the top five villages are Gaotang village, Miaopo village, Sihe village, Baolin village, and Menggong village. There are more than 100 empty nesters in the individual village; for example, the highest number of empty nesters is in the Gaotang village, with 327 older adults.

4.4 Physical health

As physical health categories shown in Table 3. Based on the physical health situation of older adults in Ziyang city, 21,615 older people have an enjoyable life with their well-conditioned bodies. Those healthy older people shall gain higher-quality life than 15,519 people suffering from endless pains due to chronic diseases, for example, hypertension, diabetes, chronic bronchitis, and others. One thousand seven hundred twelve people with a physical disability body, and 430 people are facing a horrible reality because of severe diseases.

Table 3: Physical health categories.

Physical health conditions
Healthy
Chronic disease
Severe disease
Physical disability

To link physical health status and current legal guardian. According to the query results based on those links, 16,116 older adults only obtain necessary help and medical service from nearby neighborhoods, although they all have well-health bodies. In addition, 12,066 older people are cared for by the nearby neighborhoods, and those older adults suffer from chronic diseases. As for local village committees in Ziyang City, it is an undisputed reality that local village committees must continue the caring services for these empty nesters living in the village, regardless of their physical health condition. Furthermore, nearly 1,800 older adults depend on these village committees to keep their daily lives regular. There are still 7,901 older people who are cared for by their relatives.

The query results also demonstrate that Anyue County has an incredible-size group of energic empty nesters, and the size of this group is likewise as large as that of Lezhi County, after considering the current living residential area and the health situation of older people. Another remarkable finding is that the number of old persons in Anyue county suffering from chronic ailments is around double that of Lezhi county. Seven hundred thirty-eight people have physical disabilities. They live in Anyue County. Because of physical disability, 44 older adults in the Airport Economic District struggle to perform their daily lives. Lastly, 276 people in Anyue County face tough daily challenges because of serious diseases, which is the largest size of the gathering of elderly adults with a fatal illness.

4.5 Activities of Daily Living

The ADL is an essential indicator for assessing older people's quality of life, reflecting their health condition and self-care abilities. It involves various daily activities, such as eating, dressing, toileting, continence, and ambulating[5]. Knowing the Activities of Daily Living (ADLs) of empty nesters in Ziyang city should be noticeable. As ADLs shown in Table 4. The query results reveal that most older people can have ADLs independently, but there are still 270 people who cannot count on themselves. On the other hand, 2,055 people can perform their ADLs, such as feeding or toileting, but they need extra assistance from the caring person or legal guardian.

As results shown in Figure 4. 74% of older people are cared for by nearby neighborhoods, and they built the closest ties to the nearby neighborhoods. About 7,900 empty nesters are being cared for by their relative members. A limited proportion of elderly adults are in the absence of care or help from relatives or neighborhoods. Thus, the local village committee takes responsibility as the legal guardian to provide them with medical treatment and other necessities.

Table 4: ADLs.

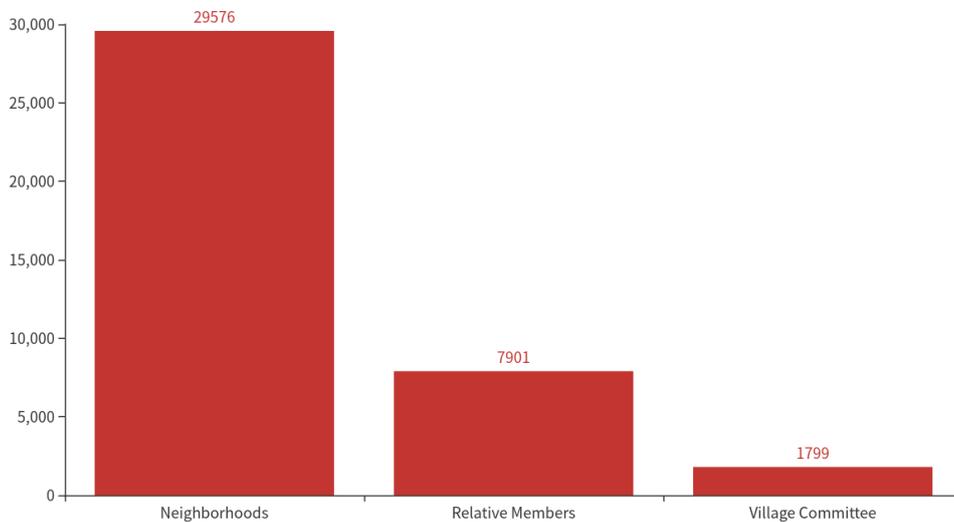| ADLs categories |
| --- |
| Full Self-care ability |
| Partial self-care ability |
| None self-care ability |

Figure 4: Legal guardian of empty nesters

Twenty-eight thousand one hundred and six people still obtain essential care from the nearby neighborhood, even with self-care ability, which makes a sizable grouping of empty nesters. Perhaps these empty nesters can cope with problems in daily life, especially health and financial ones. It is still a conceivably realistic opinion to receive care services from other people, even if there is no existing blood relationship. The crucial finding is that there is still a tiny group of empty nesters with less capability to maintain their daily life independently. They have no choice but to count on the local village committee.

These older adults in Anyue County can perform their ADLs independently and are in dynamic physical health, occupying 23% of Ziyang's empty nesters. Fifteen thousand older people with physical impairment or chronic illness continuously experience discomfort and pain daily, but they can all go about their daily lives independently.

4.6 Individual financial status

As individual financial status shown in Table 5. By Focusing on the financial status of older adults, eight thousand eight hundred seventy-five people have been labeled with exceptional poverty, meaning their annual income is below the average poverty line. Around 10% of the elderly are almost close to the average living standard. Meanwhile, the number of older people labeled with impoverished registered families is as many as half that of older people labeled with exceptional poverty. 60% of older adults have an annual income above the poverty line.

The query result reveals that one-third of exceptional poverty older people are in Anyue County. Furthermore, 2,492 people in Anyue County are labeled with impoverished registered families. In contrast, the smallest group of exceptional poverty older people is in the Airport Economic District. The proportion of aged people in Anyue County who have been labeled with exceptional poverty is the same as that of the elderly from Yanjiang District. Airport Economic District has the lowest number of older adults tagged with impoverished registered families.

Table 5: Individual financial status.

Individual financial categories
Above poverty line
Exceptional poverty
Low-income
Impoverished registered families

It is apparent to have a link between the activities of daily living and individual economic status. Nearly 55% of empty nesters carry out daily activities independently. Also, their yearly incomes are above the poverty line. In addition, a group of older people whose personal financial status is tagged with exceptional poverty or below the average living standard. The older people in that group perform activities of daily living independently. The number of that group is approximately 11,700.

After executing the queries based on multiple links between personal financial status, physical health, and the current residential area of empty nesters, the query result reveals nearly 1,600 older people in Yanjiang District. Their financial condition could be tagged with exceptional poverty, and also they suffer from chronic diseases. Remarkably, the size of the group of healthy older people with annual income above the poverty line in Anyue County is almost equivalent to that in Lezhi County.

4.7 Marital status

As marital status shown in Table 6. To query the marital status of older adults, it reveals that most empty nesters were bereft of their spouse, which is likely to account for 50% of 39,276 empty nesters. Nine thousand five hundred thirty older people had not been married yet, but 8,457 people married. As results shown in Figure 5.

Fifty percent of older people were bereft of their spouse and are now living in Anyue County. The number of older people in Lezhi County who are bereft of their spouses is twice that of older adults without a marital partner in the Yanjiang District. In Anyue County, 3,442 older adults have never been married, making up the most significant proportion of bachelors in Ziyang city. In contrast, Airport Economic District stays the lowest gathering of aged people who continue to be single, which counts 227 people.

Table 6: Marital status.

Marital status
Married
Single
Widow

After highlighting the link between marital status and the offspring of older people, query results confirm that approximately 8,940 older people had raised no offspring and were never married. Furthermore, 453 older adults had lost their marital partners and no offspring. As a result, they have no offspring to become their legal guardians. At least one son or daughter could take on the role of a legal guardian for 2,0836 older adults who are widowed. The total of older people who had a marriage and reared two offspring surges to 4,408. Surprisingly, the exact total of older people who were bereft of their spouse and without offspring is equivalent to the number of older people who never married but have reared one child.
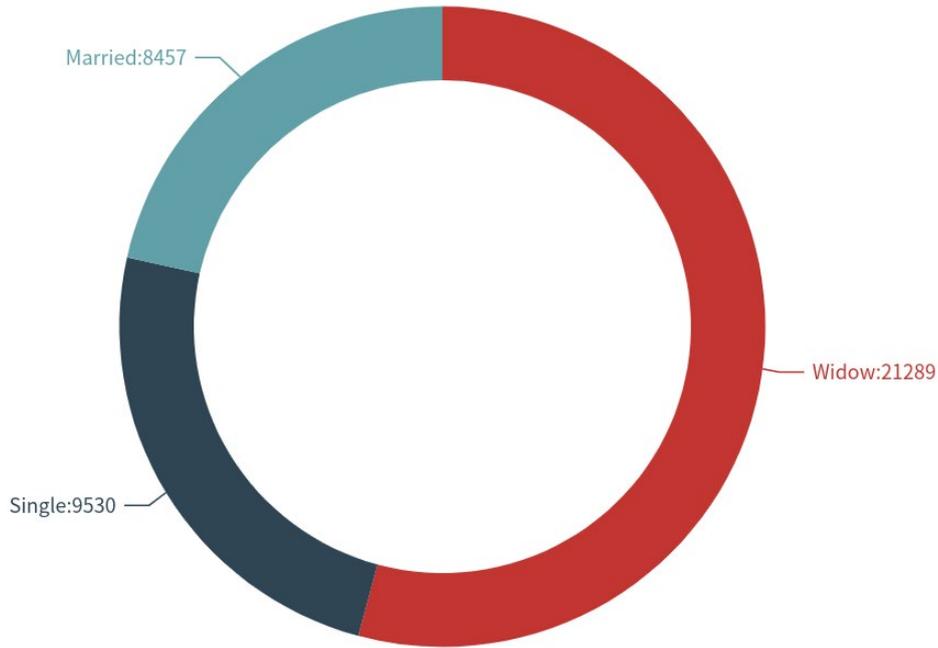
Figure 5: Marital status of empty nesters

4.8 Offspring

As shown in Table 7. After querying the number of offspring of these empty nesters, it becomes known that a great group of empty nesters, 13,070 older adults with two adult offspring. Also, the findings suggest that 10,948 older people unexpectedly gave birth to three or more children. 12% of older people reared at least one child. Furthermore, 9,559 empty nesters must cope with a grim reality. No adult offspring could handle things as their legal guardian, specifically. As results shown in Figure 6.

Table 7: Offspring.

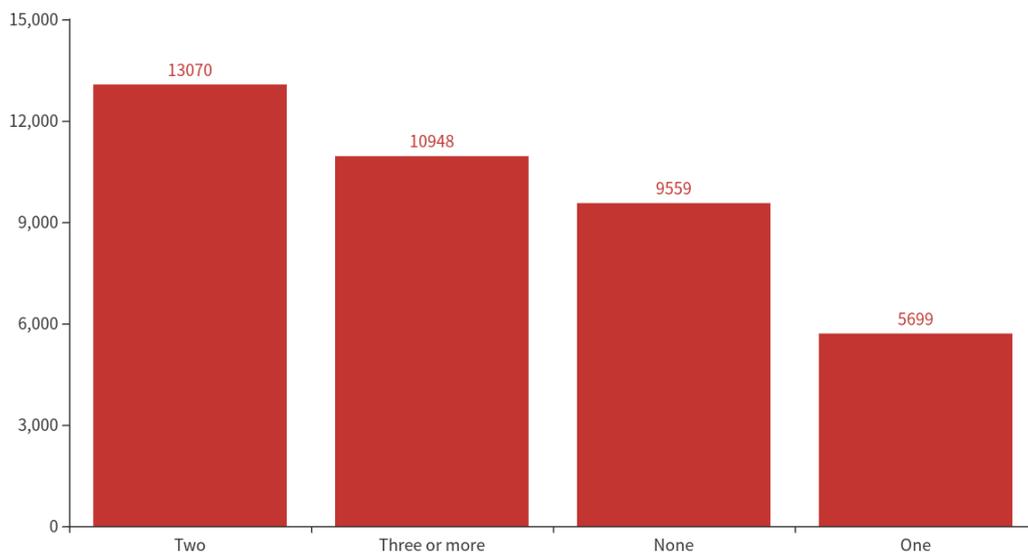| Offspring numbers |
| --- |
| 1 offspring |
| 2 offspring |
| 3 or more offspring |
| 0 offspring |

Figure 6: Number of offspring

The nearby neighborhood assumes responsibility for serving as the current legal guardian for empty nesters who have even two adult offspring. There are 10,396 of those empty nesters. Also, even with more than three adult offspring, 8,613 older people are essentially taken care of by the neighborhood. When some older adults have no adult offspring, the local village committee truly offers care and medical attention for 1,014 empty nesters. Furthermore, there are still 316 older adults who are cared for by the local village committee, with two adult offspring. As for those empty nesters cared for by relative members, the total of those with two adult offspring is similar to those with no adult offspring.

Almost 4,600 older adults in Anyue County were bereft of their spouses but had reared at least three children. There are approximately 3,200 older adults in Anyue County with no offspring, and they have never married yet. By contrast, about 1,300 older adults have a life with their loving partner and three more adult offspring in the same county.

5. Conclusions

This article suggests a practical technological method for data analysis in a data visualization way. Additionally, to extract valuable information on the lives of 39,276 empty nesters in Ziyang City. In summary, using the Neo4j database and Pyecharts could be a practical method for analyzing amounts of data. Further research is still required to address the drawbacks and inadequacies of this method.

References

[1] Y.M.Chen., Z.F.Liu., X.D.Lee., and Y.X.Huang. The aging trend of Chinese population and the prediction of aging population in 2015-2050[J]. Chinese Journal of Social Medicine, Vol. 35 (2018) No.5, p.480-483.

[2] R.L Huang., C.Yang. A Research on the Composition and living Status of the Elderly Living Alone in China[J]. Population and Society, Vol. 37 (2021) No.5, p.26-37.

[3] Y.Chai. Application of User Reading Data Graph Database Based on Neo4j[J]. Modern Information Technology, Vol. 5 (2021) No.7, p.95-106.

[4] T.H.Lee. Research and implementation of visualized data analysis based on Python[J]. Electronic Test, Vol. 31 (2020) No.20, p.78-79.

[5] Liu Le. Analysis of the Status Quo of ADL, Self-rated Health and Depression Among Chinese Elderly[J]. Medicine and society, Vol. 33 (2020) No.6, p.91-94.

[6] Dataset Source: http://www.scdata.net.cn/oportal/catalog/b72a38c49ae54e37b51e6122217db64f.