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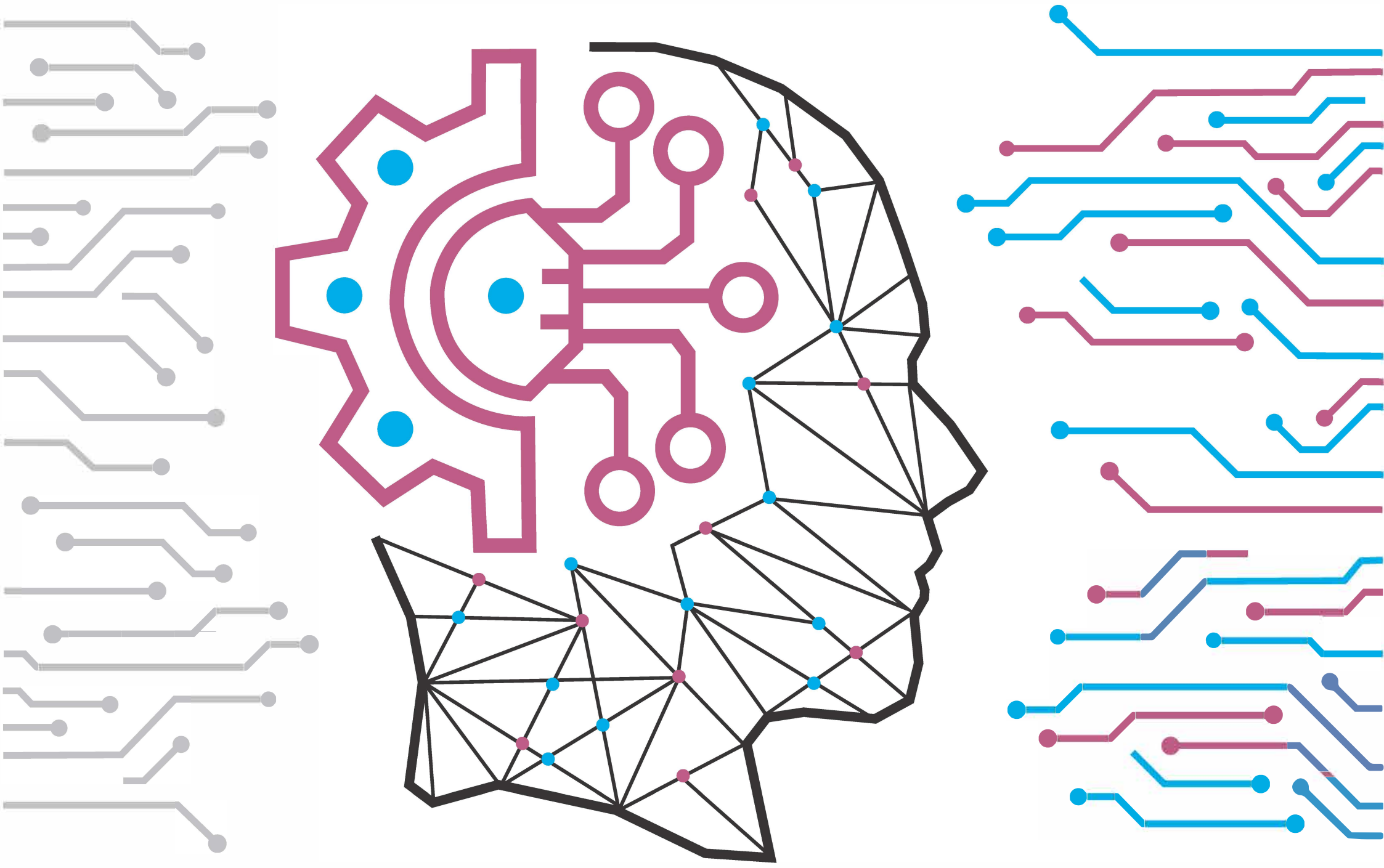

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THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

EXTENDED ABSTRACTS

e-BOOK

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e-CSq: LANDSCAPE PLANNING AND MAINTENANCE IN HEALTH FACILITIES

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ABSTRACT

Database management demands a creative and innovative approach for landscape planning and maintenance in health facilities. Health facilities require efficient database management of spatial and attribute data in landscape planning and maintenance, particularly in the mapping of trees that can contribute to environmental benefits in health facilities. Health facilities integrate gardens and landscaping for the purpose of healing, treatment, restoration, and rehabilitation. The use of Geographic Information Systems (GIS) enhances landscape planning and saves the results in present information systems for future reference, as part of the component in environmental information or decision support systems. In addition, GIS can be utilized to save data for organizing inventories, conducting scientific analyses, describing aims, describing scenarios or alternative futures, and for planning. The aim of this innovation is to develop a database management for landscape planning to create tree mapping. The database will be used by landscape contractors and maintenance professionals to identify trees exhibiting high levels of carbon sequestration, thus improving a sustainable environment in health facilities.

Keyword: database, database management, GIS, landscape planning, carbon sequestration

1. INTRODUCTION

Trees provide a beneficial influence on both physical and mental well-being. Research indicates that being outdoors in the presence of trees may reduce high blood pressure, decrease symptoms of anxiety and depression, thus enhancing overall quality of life (Rees, 2024). Having trees around a healthcare facility may benefit the health of patients, particularly those with respiratory disorders. Carbon sequestration is an important process in health facilities to improve overall quality of life, preserve ecological balance, and maintain climatic stability. According to Zhang et al. (2023), terrestrial vegetation contributes to carbon sequestration by absorbing carbon dioxide from the atmosphere and storing it in the tree or soil, therefore decreasing the concentration of this gas in the atmosphere. There has been a lack of attention on the application of mapping the trees and carbon sequestration of mature trees, particularly in health facilities, despite the fact that earlier studies have addressed the use of GIS in landscape design and maintenance. Rina et al. (2023) stated the technology for classifying tree species with the use of remote sensing is developing rapidly. According to Pu (2021), the ability to classify tree species has been made feasible by developments in remote sensing technology during the last forty years. As stated by Zope et al. (2021), the integration of GIS with other technologies has facilitated environmentalists in maintaining

comprehensive records regarding forests and decision making based on data. The recognition of GIS is related to its beneficial impact on the environment. The aim of this innovation is to develop the database management of landscape planning that consists of spatial and attribute data in order to create tree mapping. The database will be used by landscape contractors and maintenance professionals to identify trees exhibiting high levels of carbon sequestration, thus improving a sustainable environment in health facilities.

2. METHODOLOGY

This innovation uses Chen's Entity-Relationship Diagram (ERD) notation to describe and develop database structures. ERD is the most effective methodology for database development by integrating visual diagrams to represent data and information. The procedure of developing a database structure using ERD involves three different stages. This stage integrates both spatial and attribute data, which can be used by landscape planning management for monitoring works.

2.1 Stage 1: Identifying the type of data required

To provide spatial and attribute data for trees and carbon sequestration, it is important to classify the trees according to their Diameter at Breast Height (DBH). The assessment of carbon sequestration, as indicated by Behera et al. (2022), Nowak and Crane (2002), and Kanniah et al. (2014), involves the consideration of various variables which include the location, species, tree height, DBH, and geographical coordinates. To determine spatial and significant data of carbon sequestration for different categories of trees for this innovation, it is necessary to measure the diameter at breast height (DBH) of each tree. The required data include the mass of the stem (Ms), the mass of the branches (Mb), and the mass of the leaves (Ml).

2.2 Stage 2: Forming entities and attributes

The trees and carbon sequestration database requires two necessary entities: Tree Data and Carbon Sequestration. The properties of the Tree Data entity consist of five (5) elements: Group of Categories, Botanical (Scientific) names, Common names, Diameter (cm) and Height (cm). As for the Carbon Sequestration entity, it consists of eight (8) attributes: Group of Categories, Botanical Name (Scientific), Common Name, Diameter (cm), Height (cm), Stem Mass (Ms), Branch Mass (Mb), and Leaf Mass (Ml).

2.3 Stage 3: Identifying the relationships between the entities of trees data and carbon sequestration

The last stage is to identify the relationship that exists between two entities. A relationship can be determined between two entities when there is a correlation between attributes of a different entity. The importance of the relationship is related to the verb that connects two nouns (entities). The database structure for this innovation represents the relationship between the landscape contractor and the maintenance.

3. FINDINGS

Carbon Sequestration Database Management System or e-CSq which is using GIS software offers a store of database structure of landscape planning and maintenance that can be used by landscape

contractors and maintenance professionals to identify, record, locate the trees, estimate the cost of tree maintenance and plan for landscape tree management. e-CSq created the spatial and attribute data in the data development process. e-CSq uses a base map in the GIS software to digitize and locate the trees as spatial data that consist of two (2) entities which are Tree Data and Carbon Sequestration (refer Table 1). Using e-CSq in health facilities can help landscape contractors and maintenance professionals to determine the location of trees and derive important information. With this database development, e-CSq will help to arrange a proper landscape planning and management schedule and provide green spaces with highest carbon sequestration in health facilities.

Table 1 Entities and Attributes of Trees and Carbon Sequestration Database Structure

Entities	Attributes
Tree Data	Group of Categories Botanical (Scientific) names Common names Diameter (cm) Height (cm)
Carbon Sequestration	Group of Categories Botanical (Scientific) names Common names Diameter (cm) Height (cm) The Mass of The Stem (Ms) The Mass of The Branch (Mb) The Mass of The Leaves (Ml)

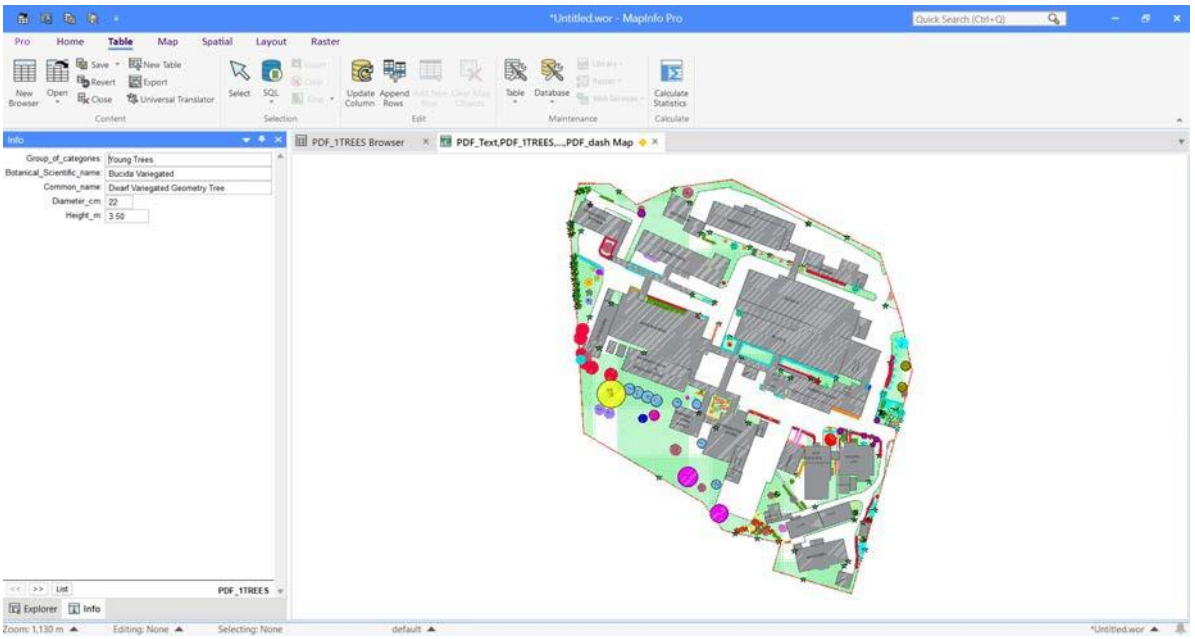

Figure 1 Examples of e-CSq using GIS software, Mapinfo

4. CONCLUSION

In conclusion, e-CSq can be used as an application in landscape planning and management for monitoring the carbon sequestration in health facilities. GIS are among the most advanced technologies in the field of landscape planning and management. e-CSq will generate tree information in health facilities using GIS software like ArcGIS or Mapinfo that can integrate spatial and attribute databases. The database development of e-CSq will perform geospatial analysis of carbon sequestration to encourage a cleaner and more sustainable environment.

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