PLANT SELECTION DATABASE FOR LANDSCAPE DESIGNERS

D.A.M.S.Silva[1][*], K. Yakandawala[1], H.A.C.K. Jayathilaka[2] and K.D.K.A.Perera[3]

[1][*] Corresponding Author, Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP),
Email: sandaru1info@gmail.com
[2]ICT Centre, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP)
[3]Technoplus Engineering, 2nd Floor, Liyanarachchi Building, Galle Road, Payagala

ABSTRACT

Plants are a group of living organisms belong to kingdom Plante under scientific classification. Trees, shrubs, herbs, grasses, vines, ferns and mosses are few of general categories of plants. Transition from hunting to farming is the first major historic milestone, where human beings started to interact with plants in a considerable way. Since then, they have discovered beautification and other functions of plants prior to food production.

Today, landscaping is a major sector in the modern construction industry. Attractive landscape design is an essential part of construction project planning, where landscape designers have an important roll to play. Reduction of natural vegetation due to building constructions can be re-established by interior and exterior plant-scaping. Incorporating plants with built infrastructure have aesthetic, health, social, economic, architectural and many other benefits. Most importantly plants create pleasing surroundings for human beings, and often they arrange plants in different ways to add value to built infrastructure. Selecting suitable plants for appropriate locations is one key aspect in landscaping projects, where most landscape designers fail to tackle. Placing plants in most suitable locations allow them to establish better, and facilitates optimum biological and ecological functioning. For landscape architects, this database can be use to select plants based on color, shape, seasonal effects and various other architectural decision making. To select suitable plants for certain location is complex task because it needs to consider multiple factors simultaneously and the decision maker needs to have sufficient multidisciplinary knowledge. A Computer aided decision support tool is handy for such kind of complex plant selection decision making.

Technological implementations such as Landscape plant selection database (LPSD) is a valuable tool in minimizing erroneous decision making in early stages of landscaping projects. This information system was developed using Java programming language and mysql database management system. Main objectives of developing this system was to collect knowledge from domain experts, books, journals, websites and other information sources into a central database and to use them in landscape plant selection decision making. This Database is capable of generating list of plants suitable for certain landscaping situations such as certain soil types and climatic conditions.

Key words: Landscape architecture, Database, Information Systems, Plants, Urban forestry

1. INTRODUCTION

Plants are the most prominent living organisms in all natural and man-made ecosystems. In Landscaping, plants are primarily employed to enhance the beauty, and also to perform some architectural and environmental functions [1].

In natural ecosystems plants can establish in places that are most suitable for their growth, and the unsuitable plants wiped-out because of their inability to adopt and survive in particular environments. This is a phenomenon described as "Natural selection" in theory of evolution [2]. When human beings alter natural ecosystems into synthetic landscapes they artificially select plants based on certain architectural requirements, but neglect environmental requirements [3]. Natural selection is a complex phenomenon affected by various external environmental factors which occur outside of the plants and internal biological factors exists within plants them selves. Therefore, it is not a surprise that artificial selection based on few architectural requirements fails more than often.

Most landscaping projects in Sri Lanka have failed due to inappropriate plant selection, and have caused damage to commercial properties, disturbance to transportation, spread of invasive species and reduction in natural beauty [4,5,6]. For successful landscape designing, plant selection should be done carefully based on considering all necessary factors simultaneously.

Selecting the right plant for the right place will help plants to gain optimal vigorous growth with maximum resistance against suppressive factors such as drought, water logging conditions, pests and diseases. Established plants perform better in landscapes [7]. When plants are grown in suitable soils and climates, they tend to function optimally. Almost all biochemical reactions and physiological functions of plants are sensitive to environmental conditions [8]. Positioning plants in the most suitable location is a key consideration in gaining optimal functioning and beauty from them.

Matching plants to suitable soil, climatic and other environmental conditions in landscapes can help to easily maintain them with less or no irrigation, fertilizers and pesticides. Therefore, Landscape architects and horticulturists should have good knowledge on plant characteristics, their geographic distribution, interaction with other plants, animals and surrounding environment, response to climatic factors and their social impact [9].

Selecting the right plant for the right place is a complex task because of the variety of factors involved and need of expert personal in accurate decision making. In that case, aid of a computerized plant selection system is vital for effective plant selection [10,11,12].

Main objectives of developing LPSD was to collect knowledge from domain experts, books, journals, websites and other information sources into a central information system and to use them in landscape plant selection decision making.

2. METHODOLOGY

Developing a database system for plant selection is a unique task. Figure 1 is a simple illustration of whole system. LPSD consist of several subsystems specialized for different tasks.
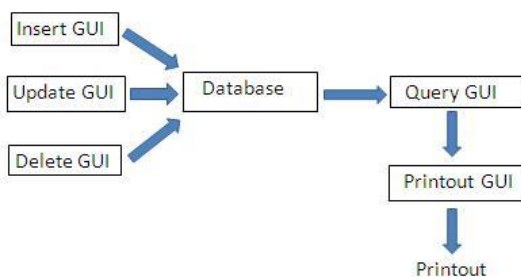

Figure 1: Major components of LSPD

List of plant characteristics included into the database are given in the table 1. Total of 58 plant characteristics were considered. An image of each

plant was also included.

Table 1: Plant characteristics included into the database

Characteristics/ Factors	Sub factors/Options
Scientific Name	Family, Genus, Species, Variety
Common Name	Sinhala, English, Tamil, Cultural
Habitat	Terrestrial, Aquatic, Epiphytic, Aquatic Associate
Climatic zone	Wet, Intermediate, Dry, Arid
Preferred soils	Sandy, Clay, Loamy
Special soil conditions	Rocky/Gravel, Swampy, Salty
Light preference	Shade loving, Medium shade, Sun loving
Plant height	Tall, medium, short
Branching pattern	Branched, Unbranched
Stem type	Single stem, Multi stem
Trunk shape	Buttressed, Fluted, Columnar
Bark roughness	Smooth, Rough
Canopy size	Wide (>5m), Medium (2-5m), Narrow (<2m)
Canopy shapes	Round, Oval, Horizontal, Columnar, Conical, Vase, Leggy, Weeping, Irregular
Thorns	Present-prominent, Present-not-prominent, Absent
Root distribution	Wide, Narrow
Root depth	Deep, Shallow
Arial roots	Present, Absent
Flower type	Single, Infloracent
Fruiting	Prominent, Not-Prominent
Leaf size	Small (<2cm), Medium (2-10cm), Large (>10cm)
Uses	Food, Medicinal, Fuel, Beautification, Shade, Screen, Dust Cover, Fragrance, Timber, Butterfly Attractant, Bird Attractant, Cultural, Religious, Soil Erosion Prevention, Pollution control
Disadvantages	Toxicity, Socially Neglected, Odor, Physical Damages, Invasiveness

Inaddition to the characteristics given in Table 1, plant organ colors (Leaf, Fruit and Flower colors), seasonal changes in plants (Leaf falling, Flushing, Flowering and Fruiting seasons), Dynamic color changes in plant organs (Flowers and Leaves) and Easiness of maintenance were also considered.

Java programming language, mysql database management system was selected to develop this information system with use of NetBeans integrated development environment [13]. Separate graphical user interfaces (GUI) were developed for each function of the system for data inserting, updating, deleting, selecting and taking printouts (Figure 1)
.

Main user interface (Front window) of the software systems consist of a menu bar with several drop down menus as shown in Figure 2. Textboxes, text fields, dropdown menus, and check boxes were employed in the insert interface. Text boxes were used to insert text strings such as names (Figure 3). Drop-down menus were used to insert characteristics with single options such as canopy shape and leaf shape (Figure 4). To insert characteristics with multiple options such as flower colors and leaf colors checkboxes were utilized (Figure 5).

Figure 2: Main user interface of LPSD
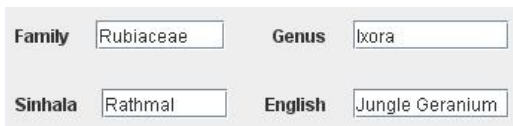
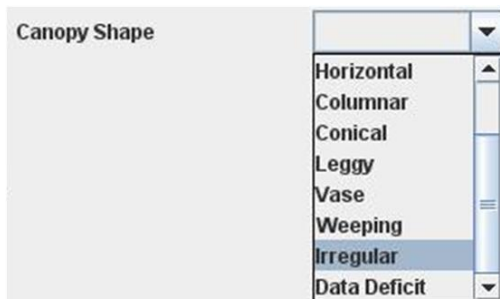**Figure 3: Inserting data via a Text boxes**

Figure 4: Inserting data via a Dropdown box

Figure 5: Inserting data via a checkboxes

Main function of Query GUI (Select GUI) is to process existing data depending on user selections (user requirements). Criteria for selecting a plant lists (Making a query/Generating a report) were based on three levels of selection. Three levels of selection were considered as primary, secondary and tertiary. Level one (primary selection) is based on climatic and environmental requirements. Level two (secondary selection) is based on ecosystem and habitat. Level three (Tertiary selection) is based on morphology and uses.

After making all three selections users' can make a query. Results (Resulted Plant list) will appear in a Table. Plant ID (SVIS), Sinhala name, English name and scientific name of each plant will display in a table (Figure 6).

By using these selections user's can execute SELECT queries that generates various plant lists. Advantage of using a Query GUI is users' do not need to have any kind of knowledge in query languages (SQL or mysql).

In addition to the Query GUI an extra feature was developed to facilitate taking printouts. All the query results (Resulted Plant lists) were passed in to a HTML document and displayed using a web browser (Offline mode).
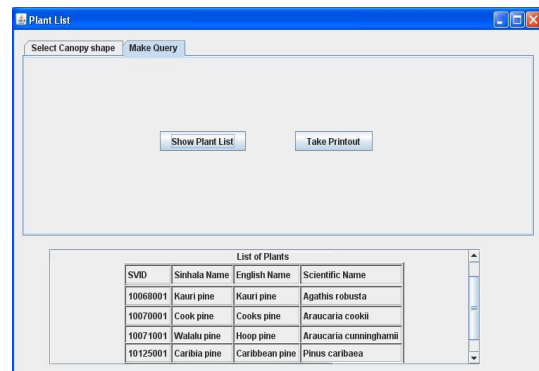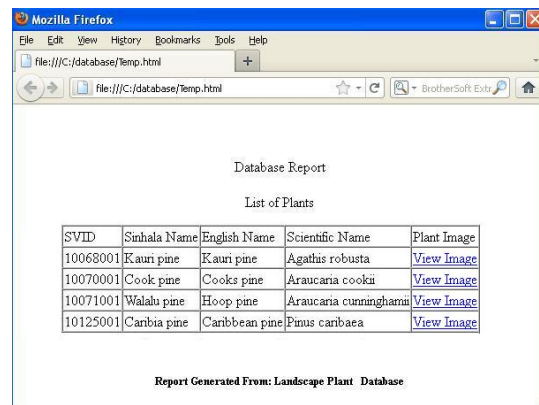

Figure 6: Query results

Figure 7: Query results displayed in offline web browser

Displaying a plant list in a HTML table is an effective method in taking printouts. Users' can

copy the HTML tables from the browser window into Word-processing and Spread sheet applications easily. Most importantly users can save the resulted Plant lists in HTML format for later use, and also saved HTML documents can be send via email.

3. FURTHER DEVELOPMENT

Data inserted into Information systems are based on human knowledge, and sometimes it may lead to errors. Mistakes also might occur because of data insertion mistakes. Therefore, users need to feed the system with more accurate data from reliable sources mainly because accuracy of output report (Plants list/Query results) directly depend on accuracy of input data. There is no standard landscape plant database development process cited in any science publication in Sri Lanka. This paper can use as a reference for future plant database and similar botanical database developments in Sri Lanka.

LPSD is only a desktop software application with limited access. It would be effective if this system could be developed as an online database which facilitates anyone to access information from anywhere in the world via World Wide Web. Furthermore, usefulness of the system can be improved as a decision support system.

4. AKNOWLEDGEMENTS

5. REFERENCES

[1]. L.M. Westphal, "Urban Greening And Social Benefits," A study Of Empowerment Outcome", 2003

[2]. M.J. Wade, and S. Kalisz, "The Causes of Natural Selection," Evolution, 44(8), pp. 1947-1955, 1990

[3]. M.D. Purugganan, and D.Q. Fuller, "The nature of selection during plant domestication," Nature, 457, pp.843-848, 2009

[4]. R. Dayaratne, "Towards Transforming Colombo to a 'Walkable' City: Policies and Strategies," Built - Environment - Sri Lanka, 9-10(01-02), 2011

[5]. T.H.S. Priyantha, G.. Karunasena, and V.A.K. Rodrigo, "Causes, Nature and Effects of Variations in Highways," Built - Environment - Sri Lanka, 9-10(01-02), 2011

[6]. R. Emmanuel, "Thermal comfort implications of urbanization in a warm-humid city: the Colombo Metropolitan Region (CMR), Sri Lanka," Building and Environment, 40(12), pp. 1591-1601, 2005.

[7]. M.C. Stoecklein, "The complete plant selection guide for landscape design," Purdue University Press, West Lafayette, Indiana, United States, 2001

[8]. J. Kellum, "Southern Shade: A Plant Selection Guide," University Press of Mississippi, United States, 2008

[9]. F.S. Chapin III, A.J. Bloom, C.B. Field, and R.H. Waring, "Plant Responses to Multiple Environmental Factors", How Plants Cope: Plant Physiological Ecology, 37(1), pp. 49-57, 1987

[10]. P.A. Babu, G. Suneetha, R. Boddepalli, V.V. Lakshmi, T.S. Rani, Y. Ram Babu, and K. Srinivas, "A database of 389 medicianl plants for diabetes," Bioinformation, 1(4): 130-131, 2006

[11]. P.F. Cliffin, "On-line Plant Selection Databases," Peer Reviewed Proceedings Digital Landscape Architecture 2011: Teaching & Learning with Digital Methods & Tools, Anhalt University of Applied Sciences, Wichmann Verlag, Offenbach and Berlin, Pp. 300-314, 2011

[12]. B.S. Anami, S. Nandyal, and A. Govardhan, "A text based approach to content based information retrieval for Indian medicinal plants," International Journal of Physical Science, Vol. 3(11), pp. 264-274, 2008

[13]. W.D. Samanwickrama, K.D.K.A. Perera, and H.A.C.K. Jayathilaka, Personal communication, 2011