Eco-Friendly Walk Score Calculator
Choosing a Place to Live with GIS

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Objective

Objective of the project
Objective

To develop an integrated methodology (Remote Sensing, GIS and Spatial Web Technology) to model urban green space walkability, which enables local residents to make spatial decision while their walking on the street or choosing a place to live with GIS.
Benefit of Urban Green Spaces

Improve Public Mental Health
Increase Social Interaction and Cohesion
Save Country Socioeconomic
Clean Environment
Improve Public Mental Health

Studies on the relationship between nature and health

Residents of neighborhoods with abundant green spaces tended, on average, to enjoy better general health (Maas et al., 2006)

More often one visits green areas, the less often one reports sickness from stress (Grahn and Stigsdotter, 2003)

Neighborhood greenness was more strongly associated with mental health than it was with physical health (Sugiyama, 2008)
Increase Social Interaction and Cohesion

Green spaces (especially parks) play important roles in **social interactions and cohesion**
- Children can play and build friendship
- People can meet and talk each other
- Do green exercises together
Save Country Socioeconomic and Clean Environment

- Reduce cooling and heating demands
- Improve air quality
- Reduce storm water runoff
- Enrichment of urban biodiversity
- Reduce urban heat island effect
- More ….
Web-GIS: Geospatially Enabled Society

GIS and Internet Technology
Benefits of Web-GIS for society
Web-GIS: Geospatially Enabled Society

GIS → GIScience → GIST (Geographical Information Science and Technology)

GIS

GIScience

GIST

Internet and Communication Technology

Development of communication technology
- ISDN > ADSL > Wi-Fi access

Development of Hardware
- Desktop > Laptop > Netbook > Smartphone

Development of User-friendly Web-GIS
- Google Earth, Microsoft Bing Maps, ...

Spatial Web Technology

WEB-GIS

GIS is more accessible ....

GIS goes professional to public

Part of our daily lives

Finding closest facility, driving routes, ...

Geospatially enabled society
Eco-friendly Walk Score Calculator

Project Area
List of Data, Processing and Purposes
Project Area

Tsukuba City (45 minutes from Tokyo, Tsukuba Express Train)
Research and academic purposes
Also known as Science City
Home of: University of Tsukuba
JAXA, NIES, AIST, ..... 
Area: 284.07 km²
List of Data, Processing and Purposes

List of Data
• ALOS-AVNR2 (JAXA)
• Building Footprint
• Administrative Boundary
• Road Center Line
• NTT iTownpage

DATA PROCESSING FLOW

ALOS (raster) → NTT iTownpage (CSV) → Road Center lines (line) → Building footprints (polygon) → Administrative boundary (polygon)

NDVI (B4-B3)/(B4+B3) → Geocoding and address matching → Clean and build network model → Database construction

NDVI Binary → Facility → Road network model → Building F.prints → Address DB

Input Process Output

NDVI binary image: Greenness score calculation
iTownpage: Allocation of facility point
Road center line: Find shortest and greenest path
Building Footprint + Admin. Boundary: Construct address database
List of Data, Processing and Purposes

ALOS-AVNR2 NDVI intensity image (DN = 0 – 255) at 10m spatial resolution
List of Data, Processing and Purposes

RGB True Color Ortho-image (67cm) | ALOS AVNIR-2 NDVI (5m)

**Green spaces**
Forest, paddy fields and grass lands

**Non-Green Spaces**
Bare lands, water surface, roads and building footprints

Convert to binary image (DN = 0 – 1)

To improve between raster and vector analysis
List of Data, Processing and Purposes

Building a GIS Road Network Data Model
List of Data, Processing and Purposes

**Building Footprint:** To construct address database

**Administrative Boundary:** To construct address database

Example:

**Japanese addressing system (Block System)**
Kasuga 3-10-16, Tsukuba, Ibaraki, Japan 305-0821

**Western or other countries (Linear System)**
701 Lee Street Suite 680, Des Plaines, IL, 60016
500 Dover Street, City Hall, Singapore

Building footprint data are useful for building population estimation by integration with number of floors information or building height derived from LIDAR data (Lwin and Murayama, 2009, 2010)
List of Data, Processing and Purposes

NTT iTOWNPAGE (Nippon Telegraph & Telephone Corp.)
Internet TownPage which includes: Business name, address, category, sub-category, business contents, phone number, URL, etc., in CSV Comma Separated Value format

To find available and desire facility locations
Measurement Modes

Get Score by Address or User Defined Point
Get Score by Walking Route (Smart Eco-path Finder)
Get Score by Address or User Defined Point

RESULT

Greenness Score = \( \frac{GA}{CA} \times 100 \)

*Qualified Distance:
  Network distance \( \leq \) User defined radius

For local residence
Get Score by Address or User Defined Point

RESULT

Greenness Score = (GA / CA) * 100
*Qualified Distance:
Network distance <= User defined radius

For potential home buyers
Get Score by Walking Route (Smart Eco-path Finder)

**Intended to:** Mobile GIS users

**Focused on:**
- How to utilize urban green spaces with GIST (GIScience & Technology)?
- How to evaluate neighborhood environmental quality with GIST?
- How to find **shortest paths** for shopping with GIST?
- How to find **greenest paths** for walking with GIST?

**Shortest Vs. Greenest Path Analysis**

**Shortest:** shopping activity

**Greenest:** for doing green exercise
Get Score by Walking Route (Smart Eco-path Finder)

- **Fastest path**
- **Shortest path**

**Shortest vs. Fastest**
- 25 km
- S → 30 km → E

**Shortest vs. Greenest**
- 3 km
- S → 1 km → E

Vegetated pixels (5m X 5m)
Non-vegetated Pixels (5m X 5m)
Greensness score
Get Score by Walking Route (Smart Eco-path Finder)

Set up: Greenness Score Limitation/Threshold (Optional)

Route Information: Shortest
P1-P2: 2.16Km (G.Score: 21)

Route Information: Greenest
P1-P2: 2.26Km (G.Score: 27)

Route Information: Greenest
P1-P2: 4.04Km (G.Score: 58)
Get Score by Walking Route (Smart Eco-path Finder)

Average greenness score by walking route

Average Greenness Score = (GA / RA) * 100
Get Score by Walking Route (Smart Eco-path Finder)

- Select location by address
- Select location by facility
- Select location by X, Y
- Multi-stop trip
- Route type selection
- Route result
- Add address to multi-trip plan
- Add facility to multi-trip plan
- Add X, Y to multi-trip plan
- Zoom all points
- Move place down
- Move place up
- Remove place
- Clear all places
- Find route
Get Score by Walking Route (Smart Eco-path Finder)

Single Trip Planning

Shortest vs. Greenest
Get Score by Walking Route (Smart Eco-path Finder)

Multi-stop Trip Planning

Shortest vs. Greenest
Get Score by Walking Route (Smart Eco-path Finder)

Provide aerial imagery for real-world visualization
Conclusion

Urban green spaces are important for human mental health improvement, social cohesion, reduce urban heat island effect, improve air quality, perform green exercises and saving energy by reduce cooling and heating demands.

GIST (GIScience and Technology) provides identification of green spaces, calculation of greenness score and route path analysis to improve local residents decision making.

Modern spatial web technology (Web-GIS) provides more accessible to a much wider audience than traditional GIS. The general public can now directly access spatial information and see the analysis results through their web browsers without any installation of GIS software. The system itself is reusable and updatable.
Thank You

URL: http://land.geo.tsukuba.ac.jp/ecowalkscore (Choosing a place to live with GIS)
URL: http://land.geo.tsukuba.ac.jp/ecowalker (Smart Eco-path Finder)