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SiteDesignCaseRetrievalandStrategyGenerationbased onExtensionSet

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Abstract

In the big data era, designers face huge difficulty in collecting numerous cases of site design on the Internet. To enhance retrieval efficiency of designers, the present study develops a method based on extension set to retrieve site design cases and approaches to formulate innovative strategies. First, data acquisition software is adopted to acquire site design case data, and the data server, database development and programming software are comprehensively and jointly employed to build a case base of site design. Second, based on the retrieval condition converted from site design contradiction, site design cases are initially screened out by correlation function, and then they achieve dynamic optimization sorting based on extension set theory, as an attempt to satisfy personalized needs of designers. Lastly, innovative strategies for site design are automatically formulated on case base. As suggested from case test, this method is capable of helping designers efficiently retrieve valuable cases of site design on the Internet, thereby presenting some theories and methods for intelligent site design.

Keywords:*Site Design, Case Base, Extension Set, Correlation Function, Innovation Strategy*

1.Introduction

Sitedesignreferstoavitallinkbetweenthespecificconstructionplanningandthegenerallayoutdesign,andittakesupacriticalpartoftheearlystageofarchitecturaldesign. Highqualitysitedesigncanimplementtheconstraintsofurbanplanningintoarchitecturaldesign,aswellasofferingstrategicsupporttoaddressthecontradictionsandinnovationproblems.ExistingbigdataintheInternetiscapableofpresentingconsiderablecasesforprofessionaldesigners.However,howtobuildanefficientquerysystemtoscreenoutandintegratesitedesigncasesandyielddesignideasbydataanalysisandminingwillbeundoubtedlyofhighsignificancetoboostingtheintelligentprocessofsitedesign.

Throughreferencingnumerousresearchmaterials,itissuggestedthatacertainresearchgapremainsinretrievalofsitedesigncase,whereasmanyresearchershavemadesomeattemptstodeveloparchitecturaldesigncaseretrievalsystemandtobuildcasedatabase.Viktor,A.[1-4]etal.fromtheInstituteofcomputerscienceatHildesheimUniversityverifiedthroughacasestudythatattheearlyphaseofarchitecturaldesign,thearchitecturaldesignretrievalsystembasedonrulesandcasescanmoresignificantlyapplytothequeryofinnovativedesignstrategies.Inthesubsequentstudy,amulti-agentretrievalmethodforthecase-basedsemanticsearchofarchitecturaldesignwasdeveloped.Cekmis,A.[5]proposedafuzzylogicapplicationforsiteplanninganddesign.Thefuzzylayoutplanningmodelemployedinthestudycouldhelpdesignersgeneratetheoptimallocationschemebysupportingtheirreasoningmodeanddecision-makingmechanism.Andrés,C.[6]etal.ofGeorgiaInstituteoftechnologystudiedtheapplicationofCBRsystemattheearlyarchitecturaldesignphaseandpres

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entedthefirstdevelopmentphaseofacase-basedreasoningsystemthatsupportstheearlyconceptualdesignofcommercialbuildings.RamonLopez,D.[7]etal.oftheInstituteofartificialintelligencesolvedtheproblemofintroducingoriginalityintothesolutionproposedbyCBRsystem.TheIDIOMsystemdevelopedbyIan,S.[8]oftheSwissFederalInstituteoftechnologyreferstoacase-basedreasoningsystemfororganizingbuildinglayout.Suchsystemallowsarchitectstoselecttheirfavoritecasestobuildacaselibrary,throughwhichhuman-computerinteractionandtheuseofpreferencescanberealizedmoreeffectively. PRECEDENTScomputeraidedarchitecturaldesignsystemdevelopedbyOxmanREandOxmanRM[9]ofHaifaInstituteoftechnology,Israel,referstoacasememorymodeladoptedtocomputerizeexcellentdesigncasesandstorethemincasedatabase,andsupportssemanticretrieval. Flemming,U.ofCarnegieMellonUniversity[10]hasextensivelystudiedtheapplicationofSEEDsoftwareattheearlyphaseofarchitecturaldesignandhighlightedthatSEEDcanautomaticallystorethesolutionsgeneratedbythesystemascasesandretrievethemforreuseundersimilarproblems;asaresult,theretrievalefficiencyofarchitectsisenhanced.Dave,B.[11]etal.ofSwissFederalInstituteoftechnologydevelopedacase-basedreasoningsystemforarchitecturalspacedesign(CADRE),capableofcombiningpartsofmultipledesigncasestopresentarchitects’noveldesignsolutions.

Byreviewingpreviousliterature,itissuggestedthattheexistingresearchexhibitsthefollowingdefectsinsitedesigncaseretrievalandintelligentschemedesign:

(1)Theretrievalresearchofrelevantcasesislargelyreportedinarchitecturalcases,andthespecialsearchofsitedesignislacked.Besides,searchforarchitecturalcasesprimarilyfocusesonlocaldatabases,andtheanalysisandsearchofInternetcaseshavebeenrarelyconducted.

(2)Insufficientmechanismtotranslatethecontradictionsinsitedesignintosearchconditions,formulatecopingstrategiesandbuildstrategylibrary.

(3)Lackedsatisfactionsortinganalysisofcaseretrieval. Underahugenumberofretrievedcases,severalproblemswilloccur(e.g.,theunevenqualityandmanualsecondaryretrieval).Evenbecausetheretrievalconditionsettingisnotsufficientlyintelligent,someexcellentcasesthatcantriggerthedesigner’sinspirationaresortedbackward,whichcannotberetrieved.

Extensionsettheoryiscapableofquantitativelyexpressingthetransformationofthings[12].Itcanindividuallyassesssitedesigncaserequirementsbyanalyzingretrievalbehaviorofsitedesigners.Giventhewidedistribution,diversetypesanddynamicchangesofInternetbigdata,thepresentstudyproposesamethodtoretrievesitedesigncasesandmethodstoformulatestrategybasedonextensionset. Besides,itattemptstolaytheoreticalandmethodologicalbasisforintelligentsitedesignbyenhancingtheInternetbigdataretrievalefficiencyofsitedesigncases.

2.Methodology

Thecorecontentofthepresentstudyreferstointegrateextensionsettheoryanddataanalysisminingtools.Undertheretrievalconditionofsitedesigncontradiction,sitedesigncasesareinitiallyscreenedoutthroughcorrelationfunctionandthensortedintermsofdynamicoptimizationaccordingtoextensionsettheorytosatisfypersonalizedneedsofdesigners.

Theimplementationpathofthepresentstudyconsistsofthreemodules,i.e.,constructionofcasebaseofsitedesign(module1),optimizationofretrievalfunctionforcasebaseofsitedesign(module2),aswellasformulationofsitedesigninnovationstrategy(module3).Module1:NutchsoftwareisadoptedtocollectsitedesigncasesontheInternet,andacasebaseofsitedesignisestablished.Module2:Retrievalfunctionforcasebaseofsitedesignisoptimizedbytheextensionsettheoryanddataanalysisandminingtools. Module3:Retrievedcaseresultsareanalyzed,andsitedesigninnovationstrategiesareformulated.(Fig.1)

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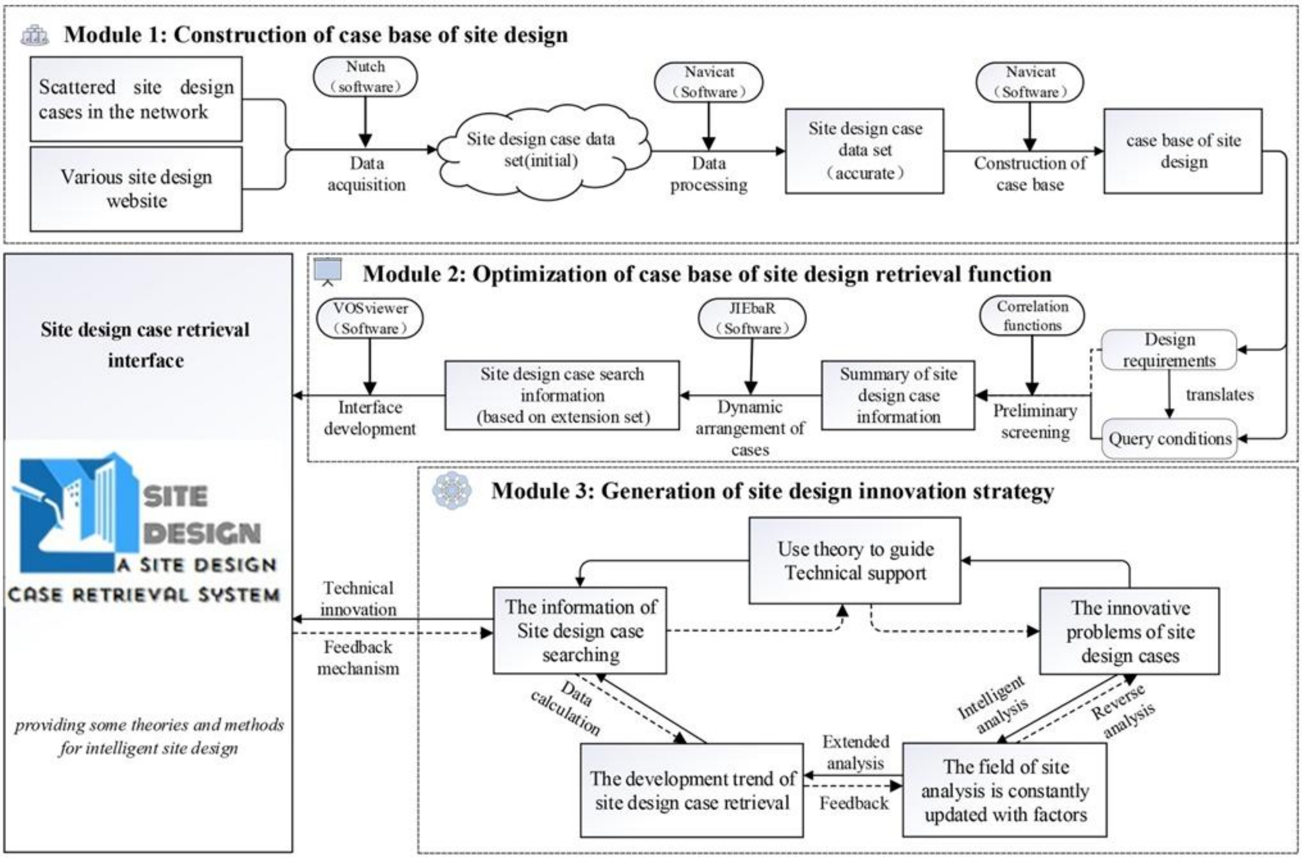

Fig.1.Sitedesigncaseretrievalmethodflowbasedonextensionset

2.1.Constructionofcasebaseofsitedesign

Sitedesigncasesummarizesthedesignobjectives,skills andexperiencesuggestedinthedesignresultswhenthedesignerperformsthetaskofsitedesign.Achievementsarelargelystoredonthe Internetasdesigntaskbook,projectplanningbook,upperplanningcondition,currentsituation photo,designtext,designdrawing,designmodel,achievementspublicityvideo,etc.Theoriginaldataofthecasebaseofsitedesignshouldbeacquiredfromthe Internetabidingbycertaincollectionrules.Themajorcharacteristicsofdatacollectionarelistedin Table1.

Table1.Characteristicsofbuildingcasedata

Source of case	Scattered cases in the network, All kinds of construction website,Thewebsiteofdesign company
Acquisitionmode	Internet collection, real-time collection, offline collection
Basic situation	Project name, project type, site location, design time, completion time, design unit, designer and project introduction
Approval of data	Project number, building height, site materials, land type, site area, building area, floor area ratio, green space ratio, building density, number of parking spaces
Review of results	Page views, comments, favorites, comments, retweets, comments
Image data	The name, Thecategory, Thetheme, Thestyle

Note:theabovefeaturesaresummarizedbytheauthoraccordingtothecaseretrievalhabitsofseveralsitedesigners,userscan adjustandsupplementaccordingtotheirownneeds.

Datacollectionofsitedesigncasesshouldcomplywiththeprinciplesofpertinence,extensivenessandtypicality,andestablishcollectionorderfromtimedimension,space

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dimensionandemotiondimension.Thecollectionprocessiselucidatedasfollows.①Searchforvarioussitedesigncasewebsitevianetworkinformationretrieval,aswellasusingNutchandothersoftwaretocollectInternetdataandupdateinrealtimeonthepremiseofpermission.Moreover,thepossiblegapofnetworkdataissupplementedbyofflinecollectiontoachievetheextensivenessanddiversityofsitedesigncasedatacollection.②Extractionofbasicprofilefeatures,generallylocatedattheendofthewebpage(e.g.,casenames,sitetypes,completiontime,andsiteapprovalindicators).③Networkengineerscansetthecorrespondingretrievalmodeaccordingtothebasicoverviewandapprovaldatalistedin Table1,aswellascombiningwebpagedesignwithretrievalrules.Booleanlogic,truncationretrieval,weightedretrievalandpositionoperatorcanbeadoptedtoenhancetheretrievalefficiencyandaccuracyofcomplexcases.Hiddeninthetextdescriptionoftheproject,considerablebasicprofilefeaturesshouldbecollectedasaccuratelyaspossiblebyanalyzingdesigner'slanguagehabitsandcomplyingwithlanguagecollectionrules.④Casereviewfallsintouserevaluationandcorrelationindexes.Userevaluationisclassifiedintothecommentcontentandtheuserrating.Thecommentcontentindicatestheuser'ssubjectiveattitudetowardsthecase,andtheratingreflectstheuser'ssatisfactiondegreeofretrieval.Emotionalanalysissoftwarecanbeimportedtoautomaticallydeterminetheemotionalcategoryofthecasereview,whichlaysasolidbasisfordataclassification.Correlationindexisclassifiedintotwotypes,i.e.,attentionindex(e.g.,pageviewsandcomments)andtherecognitionoftheindex(e.g.,theamountofcollection,thumb-upvolume,andforwardingvolume).⑤SetthedataexportruleandautomaticallyimportthecollecteddataintotheMySQLdatabase.

Withtheapplicationofcloudcomputingtechnology,computerdataprocessingushersintoanewera,andcomputerdataprocessingreceivesgreatconvenience.Cloudcomputingcanbuildcomputing,storage,networkandotherresourcesintoaunifiedresourcepoolviavirtualization,aswellaseffectivelyreducingthedifficultyofresourceallocationandmanagement[13].Thistechnologywillsignificantlyenhancethedynamicupdatingabilityofdatatobuildcasebaseofsitedesign.DynamicdatacollectioncanberealizedbyNutchsoftwareoncloudserver.

Dataprocessingreferstoavitalpreparationworkbeforetheconstructionofsitedesigndatabase,mainlyaimingtosolvetheproblemsofdataduplication,datalossanddataformatinconsistency[14].Considerablerepeateddatawillreducethespatialefficiencyofthecasedatabaseandslowdataanalysis.ThecasedatabasecanexploitNavicat'sduplicatecheckingtechnologytoretaintheoriginalwebsiteofsitedesigncasesanddeleteotherreprintedcasecontents.Insufficientkeydataactsasasignificantbottleneckinsitedesigncaseretrieval,whereasthedatainmanycasesisnotreallymissing,butnotrecognized,hiddeninthelongtextintroduction.Similarproblemscanbeflexiblysolvedthroughkeywordextraction,featureitemcollection,globalconstantsupplement,centermeasurefilling,artificialscreening,etc.[15].Overall,unifieddataformatisanimportantprerequisitefordataretrieval.Datainconsistenciesinvolvedinsitedesigncasesprimarilyexistingeographicalcoordinates,measurementunits,languageenvironment,synonymsanddifferencesofprofessionalterms,etc.TheunificationofthementioneddatacanbeachievedwithSPSSsoftwaretoestablishtheconversionruletable,whichfacilitatesdesignerstoobtainmoreaccurateandprofessionalretrievalconditiondataofsitedesign.

Toachievesitedesigndatacollection,analysis,integrationandstorage,thepresentstudywillbuildacasebaseofsitedesignbasedonMySQLdatabasemanagementsoftware.Thedatabaseconsistsofsiteconditiondatatable,naturalenvironmentdatatable,socialenvironmentdatatable,siteimagedatatable,sitedesignerdatatable,sitedesignorganizationdatatable,userdemanddatatable,administratordatatable,etc.

2.2.Useextensionsettheorytooptimizetheretrievalfunctionofcasebaseofsitedesign

2.2.1.Buildamechanismtotransformsiteconflictsintosearchitems

Theimportantdifferencebetweentheretrievalmethodbasedoncontradictionproblemsandthegeneralconditionalretrievalmethodisthatsomeunfavorablefactorscausedbythecontradictioninsitedesignareaddedastheretrievalitems.Thesolutionofunfavorablefactorsisthedifficultyandinnovationofsitedesign,andthenthecorrespondingdesignstrategyisgenerated.Besidesthebasicelements

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(e.g.,sitefunction,siteareaandsitetraffic)thatareproneto contradictoryproblems,thesearchitemsalsoconsistofthe keywordsofspecificcontradictoryproblemstermedas problemcharacteristics.Forinstance,thedesignofaburialthemesitewithhistoricalrelicsthatisplannedtobeprotectedandrestoredintheoldresidentialareahasseriousculturalconflictsbetweenthesitefunctionandthesurroundinghousingneed.Suchquestioncandeterminethesitetypeinthequestioncategoryas“memorialsite”,andthequestionfeatureas“folktaboo”orrelatedwords.

However,theinputofsuchcorrelationwordshassomedifferenceinthedescriptionofproblemcharacteristics.Forthisreason,thepresentstudydefinesthesynonymlistofsitecontradiction.Duringtheretrieval,thesystemexpandstheretrievalitemsintosynonymstableaccordingtotheimplicationanalysisprincipleofextenics;subsequently,itmatchestherelevantdataofthesitedesigncase,asanattempttoachievethegoalofaccuratelyinquiringtherelatedcontradictorycases.Theprinciplesofimplicationanalysisareasfollows:

Theproblemfeatureitemisregardedasaprimitive,whichstartsfromaprimitive,anditcancontainandextendmultiplesynonymprimitives[12],

$$M=\left(O,C,V\right)\Leftarrow\begin{Bmatrix}M_1=\left(O_1,C_1,V_1\right)\\M_2=\left(O_2,C_2,V_2\right)\\M_3=\left(O_3,C_3,V_3\right)\end{Bmatrix}$$

Forinstance,

$$M=(\text{folk taboo},\quad\text{contradiction},\quad\text{burial area and residential area})\Leftarrow$$
$$\begin{cases}M_1=(\text{national taboo},\quad\text{contradiction},\quad\text{islamic area and Catholic district})\\M_2=(\text{family taboo},\quad\text{contradiction},\quad\text{town area and outside the house area})\\M_3=(\text{personal taboos},\quad\text{contradiction},\quad\text{dynamic and static area})\end{cases}$$

2.2.2.Preliminarysortingofsitedesigncasesbasedoncorrelationfunction

Inextensionlogic,relevancefunctionisusedtoexpresstherelevanceofproblems,thatistosay,thereisacertaindegreeofsimilaritybetweenthings[15].Withthistool,therelevanceofsitedesigncasesandsearchconditionscanbescreened.Suchtypeofcorrelationscreeningisnotconsistentwithgeneralretrievalinthatitcanbepreliminarilysortedaccordingtothecorrelationdegree.

(1)Correlationdegreeofsiteindicators.Intervalcorrelationfunctioncanbeadoptedforcalculation.Besides,fourrelationaldegreealgorithmsofextenics[12]areadoptedrespectivelytosolvefourtypesoftypicalsitedesignindexquery.

①Indicatorshavedefinedrangeboundaryvalue(e.g.,aproposedtransportationhubdistributionsite)accordingtothegreenlandratesearchcase.Designersconsidersitesthatshouldreflecttheenvironmentqualityandtheiconiclandscapeimage,thepreliminarysetoftheidealvalueis35%,whilethelowerlimitofthefieldtherateindexissuperiorcontrolrulesdemandsandkeepitstrafficevacuationfunctionlimit,sotheindexoftheacceptablerangeissetto[20%,60%];thisformulacanfitthefollowing $X=<a,b>$ $M\in X$

$$k\left(x\right)=\begin{cases}\dfrac{x-a}{M-a},\quad x\le M;\\\dfrac{b-x}{b-M},\quad x\ge M.\end{cases}\qquad(1)$$

②Theindexhasaminimumvaluerequirementbutnomaximumvaluerequirement(e.g.,thesite’srequirementfortheretreatdistanceofthemainroad).Thus,thecalculationmethodofcorrelationfunctionisasfollows:

Theoptimalpointisafiniteinterval,andtheoptimalcorrelationfunctionis $X=<a,+\infty>$ $M\in X$

$$k\left(x\right)=\begin{cases}\dfrac{x-a}{M-a},\quad x\le M;\\\dfrac{M}{2x-M},\quad x\ge M.\end{cases}\qquad(2)$$

③Indexeshavemaximumrequirementsbutnominimumrequirements(e.g.,buildingheightcontrolinsitedesign).Thus,thecalculationmethodofcorrelationfunctionisdefinedbelow:

Thepositivedomainisafiniteinterval,andtheoptimalcorrelationfunctionis $X=<-\infty,b>$ $M\in X$

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$$k(x)=\begin{cases}\dfrac{M}{2M-x}, & x\le M;\\ \dfrac{x-b}{M-b}, & x\ge M.\end{cases} \quad (3)$$

④Noscoperequirements.Thistypeofsituationisspecial,generallyexistinginthesubjectiveevaluationindexofsitedesigncases.Thus,thecalculationmethodofcorrelationfunctioniswrittenasfollows:

Thepositivedomainisafiniteinterval,andtheoptimalcorrelationfunctionis $X=<-\infty,+\infty>$ $M\in X$

$$k(x)=\begin{cases}\dfrac{1}{1+M-x}, & x\le M;\\ \dfrac{1}{x+1-M}, & x\ge M.\end{cases} \quad (4)$$

(2)Regionalcorrelationdegreeofthesite.Overall,largecategoriesofcasesareselectedbyregionalclimaticcharacteristiczoningandregionaltopographyandgeomorphologycharacteristiczoningrelatedtothesitedesign.Subsequently,thelineardistancebetweenthesitedesignsiteandthecasesiteiscalculatedaccordingtothelongitudeandlatitudecoordinates.Thepremiseconditionreferstodeterminingthelongitudeandlatitudecoordinatesofallcases(e.g.,“Qingdao”into“119°30'-121°00'eastlongitudeand35°35'-37°09'northlatitude”).Afterobtainingthelineardistance,theintervalcorrelationfunctionabovecanbeadoptedtosortthecorrelationdegree.

(3)Correlationdegreeofsiteserialnumber.Onthewhole,thedegreeofcorrelationisconvertedintoindex-typefeaturesaccordingtoitsserialnumberorder(e.g.,industriallandclassificationinsitedesign,M_1,M_2,M_3,M_4Numbers1,2,3,4canbecorresponding,andthencalculatedaccordingtotherelationaldegreealgorithmofindex-typefeatures.

(4)Discretecorrelationdegreeofthesite.Inmanycases,thevalueofkeyfeaturesofthesiteisdiscrete;forinstance,thelandscapedesignstyleofthesiteismodern,classical,compromise,etc.Forthesenon-numericaldiscretevalues,theycanalsobeexpressedinthequantitativesystemof1,2and3as:

$$k(x)=\begin{cases}1, & x=A_1;\\ 2, & x=B_1;\\ 3, & x=C_1.\end{cases} \quad (5)$$

(5)Comprehensivecorrelationdegreeofthesite.Inmanycases,whenretrievingsomecomplexcorrelationdegree,itiscommonlydeterminedbythecombinationofmultiplefeatures,sotheweightofeachfeatureshouldbedeterminedforcomprehensivecalculation.Weightcanbediscussedbydecision-makers,designers,usersandotherstakeholdersviagroupfocusdiscussionandlastlycalculatedwithDelphimethod.

Whentheweightcoefficientsoffeature c_1 , c_2 , L and c_m,are λ_1, λ_2, L and λ_m ,andsatisfytheconditionsoffeature $\sum_{i=1}^{m}\lambda_i=1$,thecomprehensivecorrelationdegreeofstakeholdersisexpressedas[15]:

$$K(B)=\sum_{i=1}^{m}\lambda_i k_i(c_i(B))=\sum_{i=1}^{m}\lambda_i k_i(x_i) \quad (6)$$

2.2.3.Dynamicsortingofsitedesigncasesbasedonextensionset

Theconventionalplanningandarchitecturaldesigncasesortingmethodonlyreflectstheclosenessbetweencaseandretrievalcondition,butignoresthepotentialdemanddegreeofcasesearchers.Therefore,aftersortingthebasicrelationaldegree,users’searchhistorytracesofsitedesigncasescanbefurtheranalyzed,andthetransformationeffectofsearchrequirementscanbeexpressedbyextensionsettheory,asanattempttoachievedynamicsortingofsitedesigncasesondemand.Theprinciplesareasfollows:

ThecasebaseofsitedesignisregardedasU,andthesitedesigncaseUisanyelementinU,kisamappingfromUtotherealdomain,andTisagiventransformation,called $\Re$

$$\tilde{E}(T)=\{(u,y,y')\,|\,u\in U,\ y=k(u)\in\Re;\ \ y'=T_k k(u)\} \quad (7)$$

IsanextensionsetonthedomainU,andtheextensionfunctionof $y=k(u)$ $\tilde{E}(T)$ $y'=T_k k(u)$ $\tilde{E}(T)$ [12].

Asindicatedfromthementioneddefinitions,theextensionsetcanbeadoptedtoexpressthedegreetowhichsitedesi

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gncasesexhibitcertaincharacteristicsandthetransformationeffectof"yes"and"no"withtheNumbersin(-∞,+∞).Itcanbeemployedtoexpresstheprocessesofquantitativechange(stabilitydomain)andqualitativechange(extensiondomain).Thezeroboundandtheextensionboundcontainpointsofqualitativechange,beyondwhichthingsvaryqualitatively[12].

Thequerytracesofsitedesigncasesandsearchusersarerecorded,theevaluatedvalueofsitedesigncasesintheexistingevaluationperiodandthenextevaluationperiodisdefinedascorrelationdegreey,andTdenotesthetransformationthatcausesthealterationoftheevaluatedvalueofsitedesigncasesintwocycles[12].Wherey=k(u)isthenormalizedvalueofthefrequencyfofthesitedesigncaseuthatisconsultedwithinaperiod,asdefinedbythestandardmethodofmin-max

$$y=k(u)=2(f-f_{min})/(f_{max}-f_{min})-1 \quad (8)$$

Throughcalculation,thesitedesigncasesthatsatisfythesearchconditionsaresplitintothecorrespondingfivedomains(i.e.,thepositivequalitativechange,positivequantitativechange,negativequalitativechange,negativequantitativechange,andzero)[12].Thegradevalueandcorrelationdegreeofsitedesigncasesaresummarizedaccordingtotheweighttoformthefinalcaseextensionevaluationresult,whichlaysasolidbasisfordynamicsortingofsitedesigncases.Thistypeofcaseretrievalmethodsortedbypotentialsatisfactioncanbeeffectivelyreferencedinacase-basedmannertosolvecontradictoryproblemsinsitedesign.

2.2.4.Casebaseofsitedesignretrievalfunctiondevelopment

Toenhancetheefficiencyofsitedesigncaseuser'sretrieval,thevitalfunctionsofthecasedatabase(e.g.,Internetdatacollectionandacquisition,dataanalysisandprocessing,dataformatconversion,datastorageandquery)arefurtherdesigned.Thecasebaseofsitedesignretrievalfunctionframeworkisdesignedbyreferencingthebasicideasof GuoQiangandotherscholarsonbuildingcasedatabasesystem,withBlueGriffonv3.0.1asawebdevelopmenttoolandJsp10webprogramminglanguage,aswellasbasedonMicrosoftIIS7.0webserversoftware.(Fig.2)

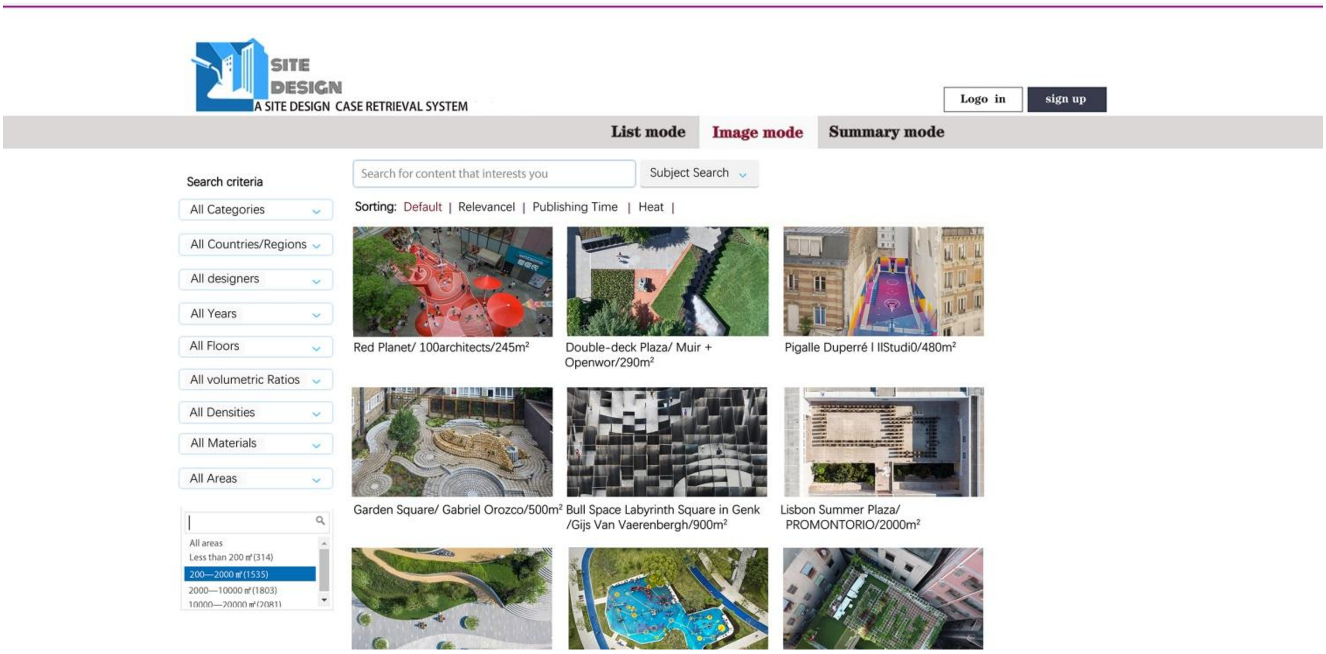

Fig.2.Casebaseofsitedesignretrievalinterface

Theretrievalfunctionofthesystemconsistsoffourareas,i.e.,displaymodesettingarea,querymodesettingarea,queryconditionsettingarea,aswellasqueryresultsortingarea.Searcherscanchoosetwoways,i.e.,designsubjectqu

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eryanddesigncontradictionquery.Inthequerycondition settingarea,searchcasescopecanbelimited(e.g.,designt ype,designer,designplace,designyear,plotratio,densit yandlandarea).Theresultsareorderedbyattention,relev ance,releasetime,orsystemdefault.Amongthem,based onthetheoryofextensionset,thecaseorderingaccording tothesearcher’sneedsisrealizedbyanalyzingtheretriev albehavior.Relevancycannotonlybeusedtocalculateth esortingofthecorrelationdegreebetweenthegeneralfeat uresofcasesandthesearchconditions(e.g.,thecharacteri sticsofreleasetimeandconstructionplace),butalsobeab letosorttheprocessingeffectofthecontradictionwiththe specificdesignaccordingtothescheme,i.e.,thesignifica ntadvantageofthissystemcomparedwiththeconventio nalcaseretrievalsystem.

Forqueryresultsdisplay,therearethreeways,i.e.,suppor tinformationlistpreview,literaturesummarypreviewan dresultsthumbnailpreview.Intheresultthumbnailprevi ewmode,severalcorrespondingsiteimageresultscanbe presentedaccordingtodifferentdrawingmodes(e.g.,the diagrampatternsofthelandscapeeffect,theplanedesign, andthenodeconstruction).

2.3.Sitedesigninnovationstrategygeneration

Innovativestrategiesinsitedesignoftenemergewiththe processofsolvingdesigncontradictions.Thissystemwil ldrawuponthepowerfuldataanalysisandprocessingabil ityofacomputertoautomaticallygenerateconsiderablei nnovativedesignstrategieswhenretrievingthecasesthat solvethecontradictoryproblemsofsitedesign.Distincti veinnovativeelements,innovativemethodsandinnovat ivetechnologiesareusedtoassistsitedesignerstobreakth roughpresentthinkingdilemmaandobtaindesigninspir ationfromnumerousideas.

Toformulateinnovativedesignstrategies,comparedwit hmanualsearchcases,theadvantagesofthisretrievalsyst emareprimarilyreflectedbelow:itcanefficientlyretriev ecasessortedbycorrelationdegreefromconsiderablecas es;withoutconsideringthebasicpropertiesofthesite(e.g .,landareaandlandcharacter),itcandirectlystartwithcon tradictionproblemsandselectthosevaluablecasesthatar econducivetosolvingsimilarcontradictioneventhough thebasicpropertiesexhibitgreatdifferences,asanattemp ttopresentideasfromtheoriginalstartingpointofinnovat ionstrategy.

3.Casetest

Sitedesignisconsideredthedesignactivitiesthatorganiz etherelationshipsamongvariouselementsofthesitebyin vestigatingthecurrent,planning,standardandusercondi tionsofthebaseandbydelvingintothefeasibilityandsites uitabilityoftheproject.Thoughsomelimitedconditions ofthesiteobjectivelycauseddifficultiesforarchitectural designandlandscapedesign,theyalsohighlightedthedir ectionfortheinnovationofthesitedesign.Throughthesit edesigninnovationtosolvethementioneddifficulties,it willbetransformedintoareferencedesignstrategyforthe subsequentdesignschemetopresentnovelideas.

Forinstance,duringsitedesign,thesteepslopeofmounta inouslandformoftenimposesconsiderabledifficultieso nthedesign.Aquestionisraisedthathowtoexploitthehei ghtdifferencetoachievetheinnovativedesignaccording tolocalconditions?Thefollowingprovidesanexampleo fthesitedesignofmountainousparktoconductcaseretrie valbasedonthesolutionofthiscontradictionproblem.

(1)Setthequerymodeto“contradictoryquery”andinputt hecontradictoryproblemtobesolvedinitsretrievalbox.I nthedescriptionofspecificcontradictionproblems,thef undamentalcontradictiontobesolvedshouldbeexpress edclearlywithprofessionalterms(e.g.,“mountainterrai nheightdifferencesuitabilitytreatment”).However,am aturecasedatabasecoversnumerouscases,architectural casesinvolvediversedesignfactors,andawidevarietyof informationareintricate,whichwillwastetimeandreduc etheretrievalefficiency.Accordingly,thesearchscopec anbefurthernarrowedbydefiningthebasicinformationa boutthecase(e.g.,designtype,designyearandlandarea)i nthesearchconditionbarontheleftsideoftheinterface.T hen,“designtype”issetas“park”.Thus,theultimatecond itionofthecaseretrievalofthewholecontradictionproble mrefersto“thesuitabilitytreatmentofterrainelevationdi fferenceinmountainouspark”.

(2)Setthedisplaymodeofqueryresults.Queryresultscan beexpressedaccordingtothreemodes,i.e.,thedesigner’s personalneedinformationlistpreview,resultsthumbnai lpreviewandliteraturesummarypreview.Inthisstudy,th

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eliteratureabstractpreviewmodeisselectedtodisplaythequeryresults.

(3)Setthesortingmethodofqueryresults.Besidesthedefaultsorting,threesortingmethods(i.e.,relevance,releasetimeandpopularity)areadded.Thecorrelationdegreereferstotheorderofthetreatmenteffectoftheschemeofthespecificdesigncontradictoryproblem.Thistime,thissortisselected.

(4)Afterthementionedstepsareset,the“contradictionquery”buttonisclickedtoretrieveandfindrelevantsitedesigncases.Withthecasebaseofsitedesignastheplatform,thetextanddrawinginformationofcasescanappear,andthesitedesigninnovationstrategycanbeautomaticallygenerated,asillustratedinthe“solutionstrategy”columnattheendofeachcase.Itissuggestedthatthesearchresultsandoneoftheexamplesistheminingsiteparkin Belgium.Theplatformaimstotreattheheightdifferencewiththemethodofsteps.Thesiteisplannedinto4gradientsbycomplyingwiththeappropriategradient,andtheplatformissetattheintersectionoftwoadjacentgradientsfortouriststohavearest.Inthiscase,thefourslopesgraduallyincrease,andthesidesofthemountainareconsideredanadventurousprismaticsurface.Thedesigncleverlyindicatesthedesignthemeofwin-wincooperation(thehigheryouclimb,themoredifficultitwillbe,whichrequirescooperationandmutualencouragementuntilyoureachthetopofthemountain).Thiscaseemploysthespecificdesignthemeandtechniquetoskillfullysolvethedesignproblemofthelargeslopelandinthesitedesignofthemountainpark.(Fig.3)

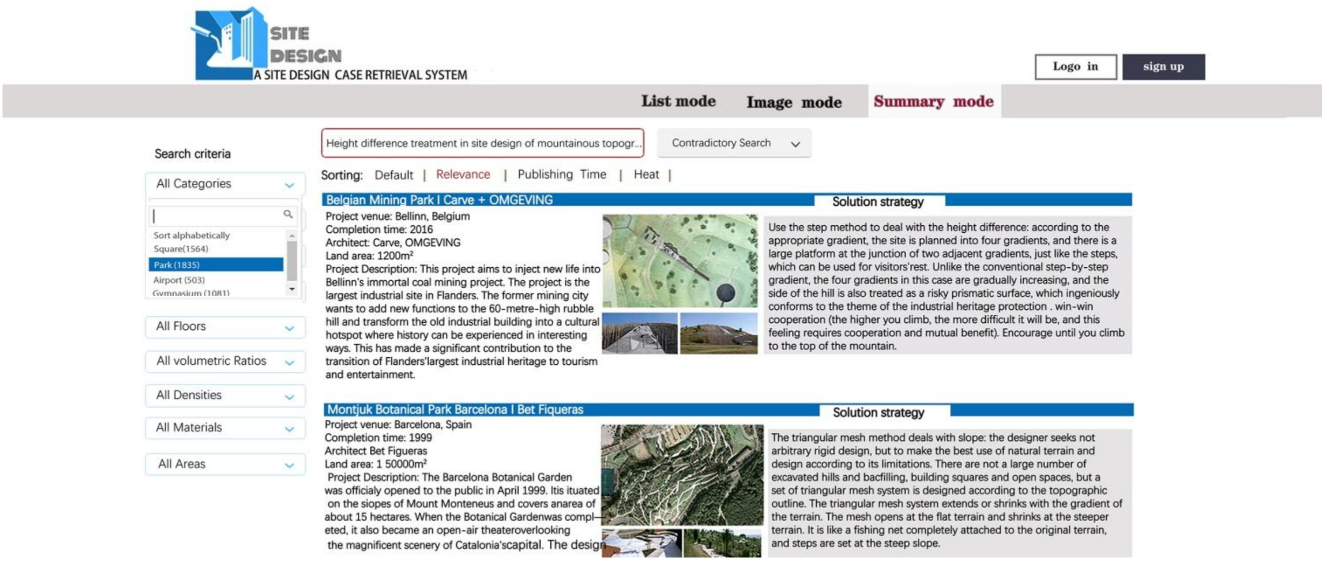

Fig.3.Searchresultsundersitedesignstrategygenerationmode

4.Conclusions

Amethodofsitedesigncaseretrievalandmethodsofstrategygenerationbasedonextensionsetrefertocomprehensivelyusingextensionsettheoryanddataanalysistools,meettheneedsofthecaseusers,convertthesitecontradictionsintothesearchconditions,applycorrelationfunctiontothepreliminaryscreeningofsitedesigncases,andexploitextensionsettoachievedynamicsortingaccordingtothesearchrequirements,astoachievetheoptimizedretrievalfunctionofthesitedesigncasedatabase.

(1)Thepresentstudyproposesthestepsofdatacollection,dataprocessing,databaseconstruction,casesortingoptimizationandsitedesigninnovationstrategygenerationofsitedesign,andassistdesignerstoefficientlyfindvaluablesitedesigncasesfrommassiveInternetdata.(2)Asrevealedfromthecasetest,thedatabaseiscomprehensive,efficientandconvenient,especiallysuitableforsitedesignbeginners.(3)Theapplicationofdatabasetechnologyandextensionmethodenhancestheabilityofdesignerstoadop tcomputertechnologytocollectandintegratedataontheInternet,aswellastoexploitdatatoautomaticallygeneratedesignstrategies,whichspeedsuptheintelligentprocessofsitedesigntosomeextent.

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