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Application of Cloud Computing in Smart Home

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ABSTRACT
ThistopicdescribesCloudComputinginSmartHome."Cloud"Computingislatestbuzzwordofthe moment and everyoneusingit.Cloudcomputingisamodelforalloweverywherenetworkaccesstoasharedpoolofconfigurablecomputingresources.Intheinitiatemethod,thearchitecturecollectsandstoreshomeappliancenformationusingCloudComputingandsendstheinformationtothecloudserverforstorageandmanagement.Furthermore,the Cloud Computing provides plentiful network resource, and guarantees the users data security. Cloud computing and storage solutions provide users and enterprises with various capabilities to store and processtheirdatainthird-partydatacenters.Nowadaysthesmarthomeisaconceptofthewidespreadcomputing.CharacteristicsandcomponentsofIaaSareutilitycomputingservicesandbillingmodel,automationofadministrativetasks,dynamicscaling,desktopvirtualization,policy-based services and internet connective. Cloud computing technology analyzes processes the information and also provides virtualization services to users. Duetoheavyloadinlocalcomputersystemanditisverydifficultfortheuserstoobtaintheinformationofthesmarthomeconcept.Thistopicreviewthesmarthomestructurebasedon Cloudcomputing,whichhelpstoreducelocalassignmentandtheusersobtaintheinformationofthesmarthome.
Keyword—Cloud computing, smart home

I. INTRODUCTION

Cloud Computing is an innovative technology that is transform the way we do computing. In cloud computing, the word cloud (also phrased as" the cloud") is used as a metaphor for" the Internet," so the phrase cloud computingmeans"atypeofInternet-basedcomputing.Themainconceptofcloudcomputingis thatwedon'tbuythehardware,oreventhesoftware,weneedanymore,ratherwerentsomecomputationalpower,storage,databases,andanyotherresource.

Cloudcomputingmakeourinvestmentsmallerandorientedtooperationsratherthantoadvantageacquisition.Butthereismuchmorethanthat Cloudcomputingreferstothedeliveryofcomputingresourcesovertheinternet.When youstoreyourphotosonlineinsteadofonyourhomecomputer,orusewebmailoraareusinga"cloudcomputing"service.

TheconceptofCloudComputingisbasedonacollectionofmanyoldandfewnewideasinseveralresearchfieldslikeService-Oriented Architectures (SOA), distributed and grid computing as well as virtualization. As aresult,cloudmodeliscomposedoffiveessentialcharacteristics,threeservicemodels,andfourdeploymentmodels.[3,4]

II. CLOUDCOMPUTNGSERVICES

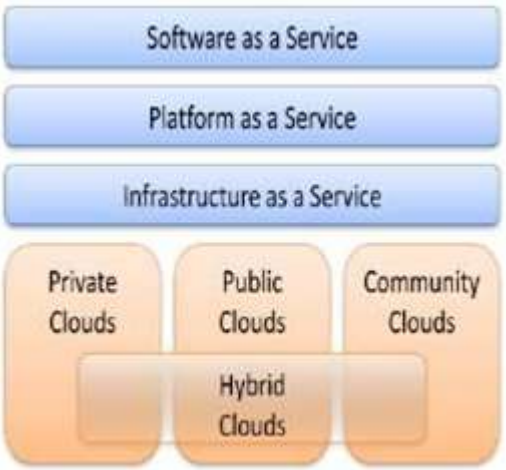

Figure1:Cloudcomputingstructure

A. SoftwareasaService(SaaS):

- Itsimplymakesuseofawebbrowsertoaccesssoftware.AtSaaSlevelusersdonothavecontroloraccesstounderlyinginfra structure being used to host the software.
- ASaaSprovidergivessubscriberaccesstobothresourcesandapplications.
- Google Docs is a popular example that use the SaaS model of cloudcomputing.

B. PlatformasaService(PaaS):

- TheapplicationaredevelopedusingasetofprogramminglanguageandtoolsthataresupportedbyPaaSprovider.
- JustliketheSaaSmodel,usersdonothavecontrolaccesstotheunderlyinginfrastructurebeingusedtohosttheirapplicationatthePaaSlevel.
- PaaSprovidergivessubscribersaccesstothecomponentsthatthey requiretodevelopandoperateapplicationovertheinternet.GoogleAppEngineisapopularPaaSexample.

C. Infrastructureasa Service(IaaS):

- WheretheusersacquirecomputingresourcessuchasprocessingpowerandstorageafromanIaaSprovider and use resource storun on their applications.
- IaaSgivesusersmoreflexibilitythanPaaSitallowtheusertodeployanysoftwarestackontopoftheoperatingsystem.
- FlexibilitycomeswithacostandusersareresponsibleforupdatingtheoperatingsystemattheIaaSlevel.AmazonWebServicesEC2andS3arepopularIaaSexamples.

CharacteristicsandcomponentsofIaaSinclude:

1. Utilitycomputingserviceandbillingmodel.
2. Automationofadministrativetasks.
3. Dynamicscaling.
4. Desktopvirtualization.
5. Policy-basedservices.
6. Internetconnective

Infra structure as a Service like Amazon Web Services provides virtual server instances with unique IPAddressesandblocksofstorageondemand.Customers usetheprovider'sapplicationprograminterface(API)tostartandstopaccessandconfiguretheirvirtualserversandstorage.
[4,2]

III. CLOUDCOMPUTNGMODELS

A. Privatecloud:

Acloudthatisusedexclusivelybyoneorganization.Thecloudmaybeoperatedbytheorganizationitselforathirdparty.Aprivatecloudisavirtualizeddatacenterthatoperateswithinafirewall.Privatecloudsaremoreexpensiveandmoresecurewhencomparetopubliccloud.

B. Publiccloud:

Apubliccloudisacloudcomputingmodelinwhichservices,suchasapplicationsandstorageareavailable forgeneraluseover Internet.Public cloud requiredsignificantinvestmentandusuallyownedbylargecorporationsuchasMicrosoft,GoogleorAmazon.

C. Hybridcloud:

Ahybridcloudisamixtureofpublicandprivateclouds.Hybridcloudallowscloudburstingtotakeplacewhereaprivatecloudcanburst-out to a public cloud when it require smoreresources.

D. Community cloud:

Acloud isshared by several organizations and is usually setup for their specific requirements. Community clouds are hybrid form of private clouds built and operated specifically for at argeted group. PaaSprovidergivessubscribersaccesstothecomponentsthattheyrequiretodevelopandoperateapplicationoverthe internet.[7]

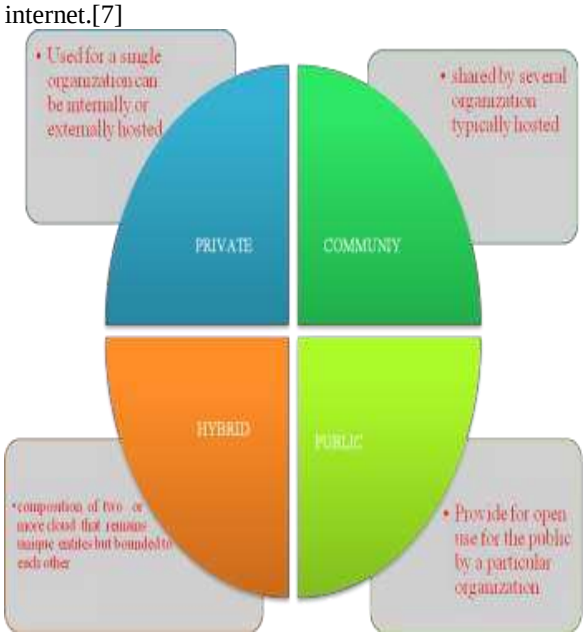

Figure2:Cloudcomputingdeploymentmodels

IV. HISTORY

1. Cloudcomputingisbelievedtohavebeeninventedby JosephCarlRobnettLickliderin the1960s.However,KurtVonnegutreferstoacloud" thatdoesalltheheavythinkingforeverybody"inhisbook"SirensofTitan"publishedin1959.
2. Sincethesixties,cloudcomputinghasdevelopedalonganumberoflines,withWeb2.0beingthemostrecentevolutionHowever,sincetheinternetonlystartedtooffersignificantbandwidthinthenineties,cloudcomputingforthemasseshasbeensomethingofalatedeveloper.
3. Oneofthefirstmilestonesinhistorywasthearrivalof Salesforce.comin1999,whichpioneeredtheconceptofdeliveringenterpriseapplicationsviaasimple website.

4. ThenextdevelopmentwasAmazonWebServicesin 2002,whichprovidedasuiteofcloud-based services in cluding storage, computation and even humanintelligence through the Amazon Mechanical Turk. Then in 2006, Amazon launch editsElasticComputecloud(EC2)asacommercialw ebservicethatallowssmallcompaniesandindividual storentcomputersonwhichtoruntheirowncomputer applications[10].

V. SYSTEMARCHITECTURE

Cloudcomputingarchitectureisthesystemsdesigno fthesoftwaresystemscontainedinthedeliveryofcloudco mputingwhichusuallyinvolvesmultiplecloudcompone ntscollaboratingwitheachotheroveralooseconnectorme chanismsuchasamessagingqueue.Cloudreferstothe components and sub componentsessential for cloud computing.

Thesecollectivecomponentsusuallyconsistofahard ware(servers,storageandband width), Infrastructure (Internet, Intranet and Intercloud), platforms (software framework), application or frontend (thickorthinclientormobiledevice).

Thefrontandbackendsareconnectedthroughanetw ork,normallyviaInternetbymeansofadeliverysystem.T hediagrambelowillustratesthegraphicaldescriptionofcl oudcomputingarchitecture[6].

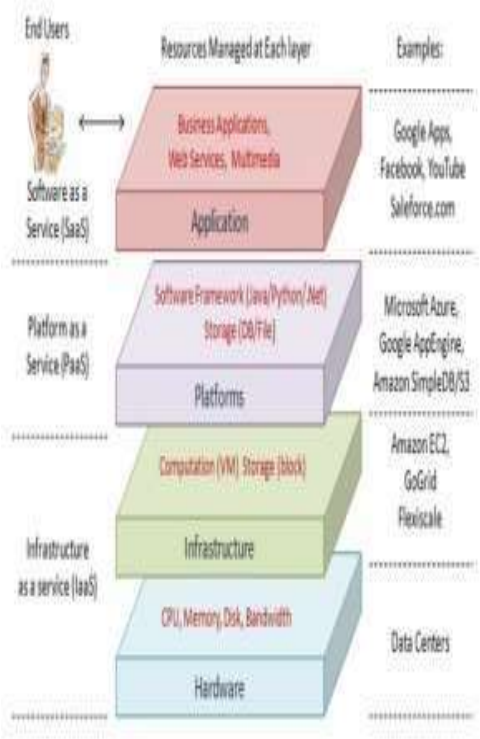

Figure3: Cloud computing System Architecture [9]

A. Hardware

- Hardwaremeansaphysicalpartofthecomputer.Buth ereitisthepartofacloudcomputingarchitecture,com prisingalltheresourcesrequiredtodelivercloud-computingservices
- A system'sbackendmeanshardwarecanbemadeupofa numberof baremetalservers,datastoragefacilities,virtualmac hines,asecuritymechanism,andservices,allbuiltinc onformancewithadeployment model,andalltogethe rresponsibleforprovidingaservice.

B. Infrastructure

- Aninfrastructureissecondstepincloudcomputingar chitecturemodel.Inwhichhardwareprovidestorage, serversandotherinfrastructurecomponentsonbehal foftheapplicant.
- Infrastructurealsoprovidershostusers'applications andhandletasksincludingsystemmaintenance,resil iencyandbackupplanning.
- Infrastructureplatformsofferhighlyscalableresour cesthatcanbeadjustedon-demand.Thismakesinfrastructurewell-suitedforworkloadsthataretemporary,experimenta lorchangeunexpectedly.
- ThehardwareandInfrastructurecomeunderIaaS

C. Platforms

- Cloudcomputingcalledasamongmanydifferentthin gs,"platformasaservice."Thisspecificnamerepresen ntstotheclientordeveloper,acloudcomputingservic elookslikea"virtualsystem"onwhichapplicationsar edevelopedorrun.
- Someplatformssupportonlypubliccloudcomputing serviceuse,otherssupportonlythecreationofprivate cloudsandafewsupportamixofboth.
- Cloudcomputingresourcesbothpublicandprivatem ayhavetomakeadecisiononwhichspecificcloudco mputingplatformtouse.
- Thewrongchoicecouldnegativelyimpacteveryone involved, so it'simportanttolookatthechoicescarefullyandconsi dershort-andlong-termissuesinyourdecision.
- Thereareanumberofopensourcecloudcomputingto ols,andseveralofthesework together with cloudservi cesalreadyavailable.TheseincludeEucalyptus,Nim busandHadoop.

D. Application

- Thisisthevisibleinterfacethatcomputerusersorclie ntsencounterthroughtheirweb-enabledclientdevices.
- Butitshould be clear herethatnotall cloudcomputingsystems willusethesameuserinterface.Applicationcomesun derSoftware-as-Service(SaaS)[4]

VI. VI.CHARACTERISTICS

A. On-demandcapabilities

- Abusinesswillsecurecloud-hostingservicesthroughacloudhostproviderwhichcouldbeyourusualsoftwarevendor.
- Youhaveaccesstoyourservicesandyouhavethepowertochangecloudservicesthroughanonlinecontrolpanelordirectlywiththeprovider.
- Youcanaddordeleteusersandchangestoragenetworksandsoftwareasneeded. Typically,youarebilledwithamonthlysubscriptionorapay-for-what-you-usescenario.
- Termsofsubscriptionsandpaymentswillvarywitheachsoftwareprovider.
-

B. Broadnetworkaccess:

- Yourteamcanaccessbusinessmanagementsolutionsusingtheirsmartphones,tablets,laptops,andofficecomputers.
- Theycanusethesedeviceswherevertheyarelocatedwithasimpleonlineaccesspoint.
- Thismobilityisparticularlyattractiveforbusinessesthatduringbusinesshoursoronoff-times,employeescanstayontopofprojects,contracts,andcustomerswhethertheyareontheroadorintheoffice.
- Broadnetworkaccess includesprivatecloudsthatoperatewithinacompany'sfirewall,publicclouds,orahybriddeployment.

C. Resourcepooling:

- Thecloudenablesyouremployeestoenterandusedatawithinthebusinessmanagementsoftwarehostedinthecloudatthesametime,fromanylocation,and atanytime.
- Thisis an attractivefeature formultiplebusinessofficesandfieldserviceorsalesteamsthatareusuallyoutsidetheoffice.

D. Rapidelasticity:

- Ifanything,thecloudisflexibleandscalabletosuityourimmediatebusinessneeds.
- Youcanquicklyandeasilyaddorremoveusers,softwarefeatures,andotherresources.

E. Measuredservice

- Goingbacktotheaffordablenatureofthecloud,youonlypayfor what youuse.
- Youandyourcloudprovidercanmeasurestoragelevels,processing,bandwidth,andthenumberofuseraccountsandyouarebilledappropriately.
- The amountofresourcesthatyou mayuse canbemonitoredandcontrolledfrombothyoursideandyourcloudprovider'ssidewhichprovidestransparency.[2,5]

VII. VII.CLOUDCOMPUTNGSECURITYISSUES

In the last few decade, cloud computing has grown from being a bright business concept to one of the fastestgrowingsectorintheITindustry.Now,economicdeclinecompaniesare growingly realizing that simply by tappingin to the cloud they can gain fast grow up to best-Of-breed business applications or effective boost their infrastructure resources, all at negligible cost.

Butbyevolvingasmoreandmoreinformationonindividualsandcompaniesisplacedinthecloud,concernsarebeginningtogrowaboutjusthowsafeanenvironmentitis.Theprovidermustensurethattheir Infrastructureissecureandthattheirclients,data&applicationareprotected.

Whiletheusermusttakemeasuretoprotecttheirapplicationandusestrongpasswordandauthenticationmethod.Therearesomesecurityissuesincloudcomputing,which areasfollows.

A. Security
B. Privacy
C. Reliability
D. LegalIssues
E. OpenStandard
F. Compliance
G. Freedom
H. Long-termViability[2]

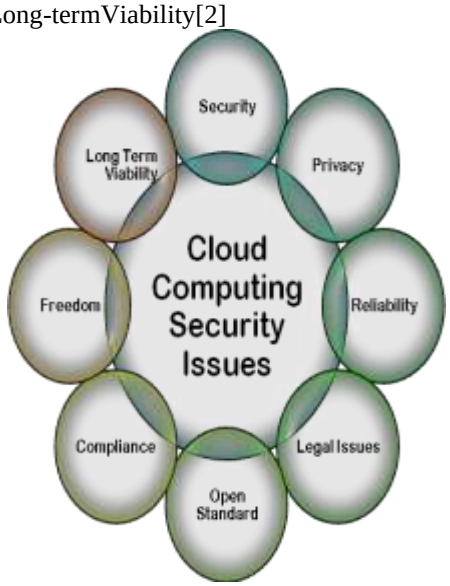

Figure4:Cloudcomputingsecurityissues[2]

VIII. PROTOCOL

InthetodayworldofCloudComputing,DataSecurityisamajorissue.Weallareawarethat,DatainInternet/Cloudshouldbe storedin encryptedform. Encryptionhelpstoprotectdatafrombeingcompromised. Encryptionhelpstoprotectdatafromanyunauthorizedaccess,thatisbeingtransferredaswellasdatastoredinthecloud.

A. Datasecurity

Sinceall thedata istransferred usingInternet,datasecurityisofmajorconcernincloud. Hereare4keymechanismsforprotectingdatamechanism slistedbelow

1. Access
2. ControlAuditing
3. Authentication
4. Authorization

Alloftheservice models shouldincorporatesecurity mechanismoperatinginallabove-mentionedareas.

B. IsolatedaccesstoData.

Sincedatastoredincloudcanbeaccessedfromanywh ere,thereforetoprotectthedata,Enterprisemusthave amechanismtoisolatedatafromdirectclientaccess. BrokeredCloudStorageAccess is one of theapproachesforisolatingstorageincloud.Inthisapproa ch,twoservicesarecreated

- Abrokerwithfullaccesstostoragebutnoaccesstoclie nt.
- Aproxywithnoaccess tostoragebutaccesstobothclientandbroker.[3,10]

IX. APPLICATION

Nowadays,weusewebtechnologywhichdeliversig nalswhichcanhelp to control electrical devices connected to the Internet which enable the users to control the many where.

ThisnewgenerationtechnologyistheintegrationofCloud ComputingandSmartHomeCloudComputingisthedeliv eryofcomputingasaserviceratherthanaproduct.

A. SystemArchitecture

- TheuserscanaccessthesystemthrougharemotePCo rsmartphoneconnectedtotheInternet.Thedesigned userinterfacetocontrolandmonitorthesystemisawe bbasedapplicationwhichisinstalledinthecontroller.
- ThesaidcontrollertransmitsthesignalstotheelectricalswitchesinterfaceThisinterfacetogetherwiththec ontrollerusesacodingprotocol(allswitchedon/alls witchedoff/-stateperport)forcommunication.
- Thesystem'swebsitedisplaystheelectricity.Consu mptioninformation andthisinformationcamefromthemonitoringinterf acewhichgetsitsdatafromthesubmeter'ssignal.Toe nsurethereliability ofservice,thecontroller,interface,andloadareallcon nectedtotheUninterruptablePowerSupply(UPS).
- SmartHomeElectricityManagementSystem(SHE MS)compliesthefeaturesneededinfacilitatingtheco ntrolofElectricalsystemremotely.
- Itcanshareresources,software,andinformationtoco mputersandotherdevicesasautilityoveranetwork(t ypicallytheInternet).

Mostofmultinationalcompaniesareusingthistechn ologyprimarilytocutcosts.Thistechnologyprovidesreso urcesandinfrastructureasasourceratherthancapitalexpe nditurethatwouldmitigatetheinstitution'soutlayonresou rces.

IBMsaidthat"Cloudcomputingishelptoreduceby4 0percentthecostsinhardwareandsoftwaremaintenance, whichmakeuparound30percentofatypicalcompany'sop erationalexpenses".[1,3,8]

B. TheDevelopedSystem

- Thissystemismade byMarvinR.Garciaandhisteamthroughthistopic.Ia monlypromotetheuseofSmartHomeconcept.
- TheSmartHomeElectricityManagementSystemUs ingCloudComputing(SHEMS)consistsofa hardware interface,ControllerWebsiteandthesoftwareapplic ationformonitoringtheelectricalswitchcontrol.
- Thedevelopedsystemisintegratedwithelectricityfl owswitcheswhichcontroltheappliancesswitchingo nandswitchingoffremotely.
- Thisfeaturemayencouragehouseholdstobewatchfu lonenergyconsumption.
- Thesaidsystemcanshut outaccessfrom anyonewhowillattemptandexploreitwithnorecogni zedcode.
- ThismechanismprotectsSHEMSfromthosewhowi lltrytogainunauthorizedaccessthatwillviolateitsse curity,interfereitsavailability,dataintegrityanditsc onfidentiality.[1]

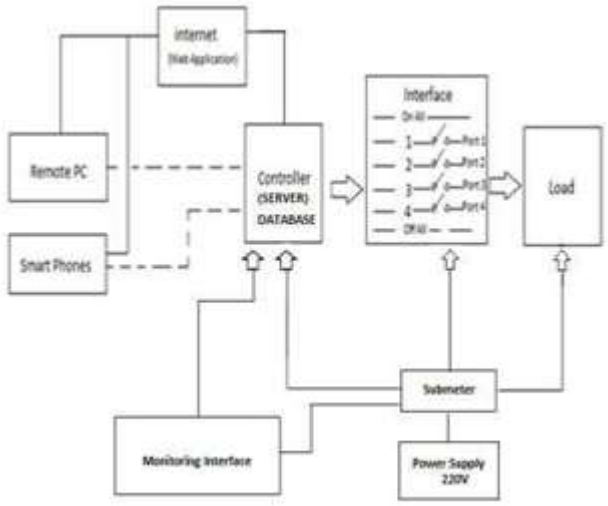

Figure5.SystemArchitectureofSmartHomeElectricity Management System using Cloud Computing (SHEMS) [1]

C. SmartHomeProtocols

- Smarthomedevicescanbefragmentedwiththeuseof variousproprietaryprotocolsandstandardswhosein

tegrationisverydifficulttobeachieved.

- Themostimportantproblemtosolveforsmarthomeenvironmentstructureistheintegrationandinteroperabilityamongdifferentvariousdevices.
- AlltheheterogeneousdevicesareconnectedtoInternet.Moreover,asmarthomemayincludeICTdeviceswithIPcommunicationandnon-ICTones,suchassensorsdeviceswithnon-IPcommunication.[8]

X. CONCLUSION

Inastudyoftheresearchliteraturesurroundingcloudcomputing,Ifoundthatthereisadistinctfocusontheneedsofthescientificcomputingcommunity.BigITcompaniesarealsobuildingtheirownversionofcloud.Butstillthereare manyquestionhaveleft withoutananswerandindeedthemostimportant oneissecurity.

WiththeadvancementofCloudtechnologiesrapidly, thereis a new need for tools to study and analyze the benefits of the technology and how best to apply the technology to large-scaled applications. The proposedmethodconsiderstheschedulingproblemasthe assignmentprobleminmathematicswherethecostmatrix givesthecostofatasktobeassignedintoaresource.

Herecosthasbeenconsideredascreditortheprobabilisticmeasurementthusonlytheprocessingtimeofajobisnotbeengivenimportancebuttheotherissuesareconsidereddsuchastheprobabilityofaresourcetobefreesoonafterexecuting a task so that it will be available for other waiting job.

Jobwhichhasthehighestprobabilitytogetaresourceaswellastheresourcewhichfitsbetterforajobisassignedinamannerthatoneresourcegetonejobatatime.Also byusingCloud ComputinginSmart Home,weavoid lossofelectricitywhichhelpinfuture.

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