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AUGMENTEDREALITYBASEDREALTIMEAUTOMATION FORIOTDEVICES

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Abstract: In the recent decade home automation is a issue that isbecomingmore andmorepopular duetoitsimportanceandSecurity purpose. Much real-time home appliance in terms ofcloud can be connected and interfaced with internet connectivity.Due to its simplicity and equal accessibility of automation it hasbeen peaked in the last few days. A cloud-based platform helpsyouconnecttoyourfacility'senvironment,allowinganyone,anywhere, anytime, and anything which is to be accessed in auser-friendly way through a custom website. Hence the final rootcausetobecloudwhichstoresthedatarelatedtohomeautomation. Herewecoversystemsthatallowdevicestobecontrolledviaawirelessnetworkoracloud-basedapproach.This project uses an IoT based home automation system. Theautomation system can be controlled from a central PC via theInternet or accessed remotely via a PC with a Windows-basedoperating system. Augmented reality is a successful technologythatfacilitatesperformingcomplextasks.RealityAugmentedcombinespracticalitywithreality,givingusersnewtoolstoensure the efficiency of information transfer in some processesandinsomeplaces.Theresearchcommunityhasproposedvarioussolutionsbasedonaugmentedreality.Especiallyaugmented reality rehabilitation tools that offer new ideas andpromiseamazingprogress.

I. INTRODUCTION

Our expectations for a higher standard of living arerising rapidly as automation advances day by day. A highstandardoflivingmeanstheuseofsmartdevicesthatmake human life easier. Smart homes appear to be "smart"becausetheircomputersystemscanmonitorvariousaspectsofdailylife[1].Inaneraoftechnologicaladvancement,automationisonlyamatter oftime.

The purpose of home automation is to change people'slives. Home automation switches allow you to control yourhome appliances with your smart phone, smart glasses, orsmart watch without using traditional switches. The recenttechnology models could be augmented by the IoT baseplatformin which sensors are distributed throughout thehomeenvironmenttomonitorusers'healthandenableremoteassistance [2].

Introducing AR interfaces to automation has been ahuge success, as demonstrated by the superior perceptionand interaction. Customer must provide a largewebsitecontaining information about things and data that can betransferred into the environment. Therefore, the augmentedrealityprovestobeauser-friendlyinterfacetohomeautomation and this model has image processing whichserves as the backbone of the entire system. Our proposedmodel is based on Unity 3D and AR and uses the conceptof image tracking and processing on background servers tocontrol electrical and mechanical objects. In addition to thecomputingpowerofsmartdevices,theircameras(cameras) are also greatly improved, so the real potential isbig enough to highlight the role of smart devices in theworld of the Internet of Things. . Integrate the user, thephysicalworldandtheinternettotakecommunicationto

A major need in themanufacturing industry today istosavequalifiedlaborandcontinuouslycollectandevaluate datafromallprocessesatalllevels.Wearetalkingaboutdigital twins,errorprediction,serviceinterventionorprocessmodels foroptimizationandproduction control. Digitally alteredreality, along withthe Internet of Things and artificial intelligence, will be acontinuous and timely source of information, alerts, andevents..

The aim of the module is to create a scheme that cancontroltheInternetofThingsusingmixedreality.Develop ing such systems requires a multidisciplinary andcomprehensiveapproach.MixedReality(MR)istheblen dingoftherealandvirtualworldstocreatenewenvironmentsa ndvisualizationswherephysicalanddigital objects coexist and interact in real time. MR isoverlay synthetic real-world content that is anchored toand interacts with the real world. A key feature of MR isthat synthetic and real content can react to each other inreal time. Mixed reality technologies include MicrosoftHoloLens(WindowsMixedRealityplatform),Ap pleARKit,andAndroidARCore.

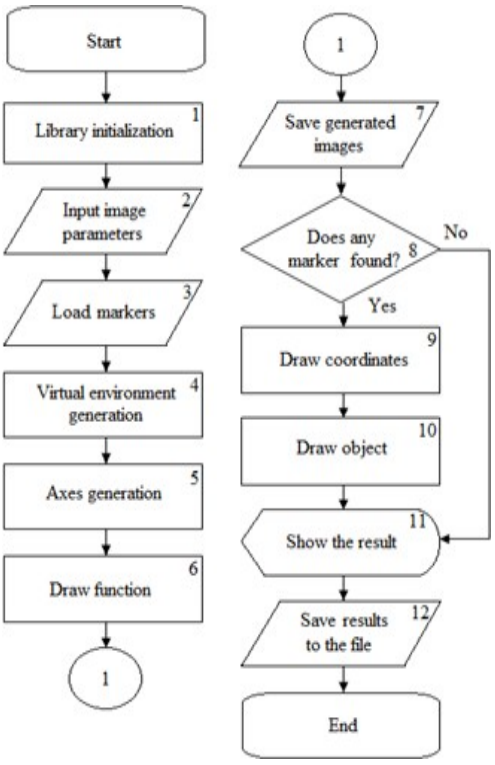


Fig.1: ElementaryFlowChartofAugmentedReality

II. RELATEDWORK

In analyzing the state of the art for the problemssolved,wehaveplacedgreatemphasisonscientificre search and searching for existing solutions in this field.The idea found showed the following possibilities: Controland monitor mechatronic systems in IoT networks usingaugmentedormixedreality.Anotherimportantconsidera tion is whether the project was developed andimplementedusingopensource code.

[7, 8] mention the use of standard communicationprotocols that should be used when designing IoT systemsthat implement web standards. This creates the so-calledWeb of Things. The Web of Things is designed so thatsystemscanbeeasilyintegratedintothemodernweb.There fore, the idea is to build a common application layerfor IoTbased onwebtechnologies andprotocols. Thisideawassubsequentlyexpandedtoincludethetermaugme ntedworldinRef.[6].Theaugmentedworldconcept can be defined as software applications that adddigitalobjectstothesurroundingphysicalenvironment(citi es,buildings,spaces,etc.)withwhichauserorsoftware agent can interact. The concept of the Web wasborn out of the combination of the Web of Things and theAugmented World.

The concept of extensions is presented in Ref. [4].The idea is to create a database of digital copies of real-world objects (usually consumer electronics, for example)andassociatevariouspiecesofinformationwiththem .This is, for example, maintenance information, instructionsforuse,etc.Aftercapturingareal-lifeobject (a digitalcopyofwhichisinanaugmentedrealitydatabase),infor mationaboutthisreal-lifeobjectisdisplayedinaugmentedrealityonthescreenof yourmobiledevice.

The focus of the research is the concept of authorPhilip Lewicky [7]. He created a demonstration applicationthatallowshimtocontrolhisPhillipsHuesmartbulb usingaMicrosoftHoloLensheadset.WiththehelpofHoloLens, I was able to select a specific light bulb lightcolor with a simple gesture in augmented/mixed reality.Theauthorrealizedthattoday'ssolution allowshim tocontrol the light bulb through a mobile application. Thenyou have to find the specific room and light bulb you wanttocontrol.Thisisnotalwayspractical.Itismoreconvenient tousetheheadsettocontrol.Howevertheconceptdescribed doesnotapplyfurtherdeveloped.

There is a concept by designer Ian Sterling andengineer SwaroopParra[19]. This concept shows how touse gestures to control smart devices. It uses MicrosoftHoloLens. The task was to provide his UI for an AndroidmusicplayerandanArduinomicrocontrollerwithalig htedfanattached.Asinthepreviouscase,thisisasingle-purposesystemrather thanacompletesystem.

Abettersolutionisgiveninreference[9].Thepresented AR/MR-IoT framework uses standard and opensourceprotocolsandtoolssuchasMQTT(MessageQueui ngTelemetryTransport),HTTPS(HypertextTransfer Protocol Secure) and Node-RED. This solution isbased on QR codes. This article mainly focuses on thetemporalaspectsofcommunicationintheframeworkpresen ted.

Acomprehensivecommercialsoftwaresystemfordiagno singandcontrollingmechatronicsystemsisVuforiaStudio[21](previouslycalledThingsWorxStudio). The rebrand follows technology company PTC'sacquisitionofaugmentedandmixedrealitylibraryVufo ria. Such an acquisition was a natural step, as PTChas been very flexible with the emergence of Industry 4.0andindustrialIoTconcepts.VuforiaStudioutilizesclosed-sourcetoolsthatallowyoutocaptureandrecognizemechatroni c devices, then insert 3D and 2Dobjects that appear in augmented reality. This technologydoes not recognize devices directly, but uses a unique 2DThingMarktag.Thisisactuallyalegacytechnologysimilar to QR codes. The content is then visualized inVuforiaView.

ŠKODAAUTOannouncedasmartmaintenanceproject that uses augmented reality for maintenance tasks[22]. A Microsoft HoloLens headset is used. This is arelativelysimplesoftwareapplicationthatusestheHoloLens camera to recognize metal pipes with handles.The goal is to diagnose grip spacing that can change overtime.Withtubedetection,therealobjectiscoveredwithad igitaltubewiththehandlesinplace.Usingvisualinformation, you can easily see the displacement and fixthe handle to the position of its virtual counterpart. Thistypeofmaintenancesimplifiesandspeedsupthetechnicia n'sworkasthereisnoneedtoconstantlymeasure distances.A custom 3D enginewas developedfor theapplication. However, afteractuallytesting theapplication within the solution in [23], we can say that theapplication was not responsive to lighting conditions andwasalsolimitedby theHoloLensheadset.Hologramswere too thin to copy objects properly. My field of visionwas limited. So the real benefits of the presented solutionarequestionable.

III. DESIGNOFTHESYSTEM

A. VuforiaEngine

Vuforiaisapopulartaxpayersoftwaredevelopment kit (SDK) for mobile devices that enables thecreation of unpopular virtualapps. Track and track 3Dimagesandobjectsinrealtimeusingcomputer-aidedvisualrecognitiontechnology.Thisimageregistrationfe atureallowsanengineertopositionandalignvisualobjects, such as 3D models and other media, to real-worldobjectswhenviewedby thehandhelddevice'scamera.increase. The object then tracks its position and location inthe image in real time, so that the observer's view of theobjectmatchesthatofthetarget.TheVuforiaSDKsupportsh is2Dand3Dmodelsoftargets,includingunmarked images, 3D target models, and a customizablefiducial marker type known as VuMark. Other features oftheSDKincludelocal6-degreeroomdevicecreation,local occlusion using "visible buttons", timely image targetselection,andtheabilitytosystematicallycreateandresiz e target sets on the fly. It is included. Vuforia usesUnitygameengineextensionstoprovideapplicationprogr amming interfaces (APIs) for C++, Java, Objective-C++, and .NET languages. In this way, the SDK supportsbothnativeiOS,Android,andUWPupgradeswhileall owing AR Unity applications to be developed on bothforums. Today's youngest generation focuses on charactereducationandwasbornwithICT(Informationand

Communication Technology). Therefore, I would like torecommend the use of ICT such as AR. AR (AugmentedReality) is a system that fills the real world with objectsthatappeartoexistinthesamespaceasthereal world[3].

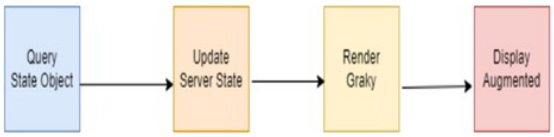


Fig.3:VuforiaEngine Process

Software must be able to send and retrieve datafrom all existing system components. At the same time, itshould be possible to integrate other components that maybeaddedtothesysteminthefuture.Themobileapplicationr ecognizestheselectedobject,displaysselected information from the smart home's sensors in realtime, and controls and modifies the selected component ina specific way based on what it obtains. Must be able todisplay mixed and augmented reality or generated virtualcomponents.data.

B. Bylnk

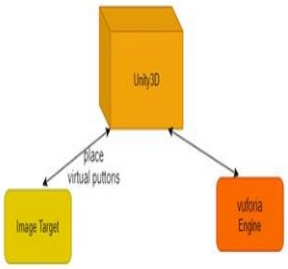
The system is designed and operated by Blynk tomonitorandcontrolconsumerelectronics.Deviceperformanc eisrecordedandmanagedbythenetworkcoordinator. To do this, use a WiFi network that uses amodernADSLWiFirouter.SSIDnetworkandWiFisecuritypar ametersarepre-configured.Securitytargetmessagesstarttheprocessusingthe VisualHomeAlgorithm and, if deemed safe, are rewritten and sent to thereal home network devices. In the Blynk network, the Blynkcontrollersendsmessagestotheend.Securityandprotecti onofallmessagesreceivedbyVisualHomealgorithms help reduce system costs and influence adoptionofBlynkcommunicationsystemsequences.Manynew breakthroughs were made during this period, including toolsand systems that facilitate everyday human activities. Tohelpwiththis,manyorganizationsaretryingtocreatehumanb enefitssuchassystems,electricaldevices,androbots[4].

C. UNITY3D

Unityisacross-platformgameenginedevelopedby Unity Technologies, first announced and released as aMac OS X-only game engine at Apple Inc.'s WorldwideDevelopers Conference in June 2005. Since then, the enginehasbeengradually extendedtosupportvariousdesktop,mobile, console and real-time platforms. Most popular formobilegamedevelopment on iOS andAndroid, usedingames like Pokémon Go, Monument Valley, Call of Duty:Mobile, Beat Saber, and Cuphead. It is considered an easy-to-usetoolforbeginnersandispopularforindiegamedevelopment. Thisenginecanbeusedtocreatethree-dimensional (3D) and two-dimensional (2D) games, as wellas interactive simulations and other animations. This engineis used in non-video industries such as film, automotive,construction, engineering and construction, as well as in theUSmilitary.TheQRcodenamecomesfromQuickResponse and the code is designed to be decoded quickly.Thisisatwo-dimensionalbarcodeprintedonpaperor

digitally.Youcanuseyourmobiledevice'scameratodecryptencryptedinformation.AQRcodeisasquarematrix made up of square modules. QR code color is blackandwhite.AdvantagesofusingQRCodesincludetheability to quickly generate new QR Codes for building andextending application systems. The next advantage is thateachdeviceorsensorcanhaveauniqueQRcode,sotheQR code can be used to distinguish objects of the sameshape. The drawback is that the mobile device must be keptparalleltothecodeandcloseenoughtothedeviceduringtherecognitionprocess.

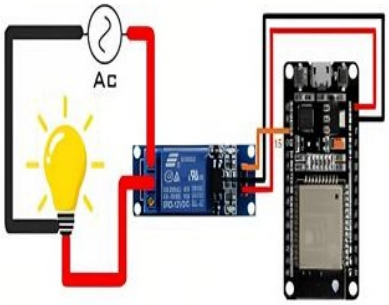
Fig. 4 : Augmented Reality Block for placingvirtual buttons ontheimage target



The Unity game engine was launched in 2005 withthe aim of "democratic" game development by opening it upto a wider audience. The following year, Unity won himsecond place in the Mac OS Xgraphics category at theApple Inc. Design Awards. Unity was first released for MacOSXandlatersupportedMicrosoftWindowsandwebbrowsers.Unity3Disanewkindofprofessionalgameengine with powerful magical features not limited to gamedevelopment. Currently, the use of Unity3D is focused ontheproductionof2Dand3Dgames,thesoftwareisconstantlybeingdeveloped,theworkisgraduallybeingstrengthened, and the use of other functions is graduallybeingdeepened.Unity3Dmarksaneweraingamedevelopment,withfar-reachingprospects andbig impact[5].

ProposedIOTModelArchitecture

Fig.5:CircuitDiagramofIOTModel



The circuit above represents an IoT connectionfor controlling an AC device, with esp32 connected to theinput of a relay via one of its GPIO pins. Relay module iselectronic activate the switch to turn the circuit on or off.The main purpose of the relay module is to handle highervoltages/currents than the microcontroller can handle. Usea5Vrelaymodule.Itconsistsofthreeconnectionscalled

terminators, which are NC (normally open), NO (normallyclosed) and COM connectors [17]. On the other side aretheVCC,GNDandINpinsthatneedtobeconnected.Therela ymoduleusescurrenttoopenandclosetheswitch using acoil thatattracts andpulls thecontacts ofthe switch and a coil that pushes the contacts apart with aspringwhenthecoilisnotpowered.Theappliancecableis split into two parts, which are connected to the COMand NC ports, with the VCC pin connected to the Vin pinof the esp32. in a flashing android. The app creates a newproject and places a button widget insideit. The Blynkapp typically sends the API key token to the email addressusedtocontroltheappliance.C++codeiswrittenonArd uino.TheIDEandcodeareuploadedtotheesp32board to control the consumer electronics. Used to controlvirtualpinsonBlynkdevices.Theauth_tokenfieldwill be replaced with the BlynkAPI key token and the "Pin"fieldischangedto"V1(virtualpin)".Andthevaluetoggle s on and off to 0 or 1. A block diagram of the IoTpartisshowninthefigure.Figure2showshowthecommuni cation process for controlling home appliancesworks.Figure5isaninterfacediagramofhomeappli ancesusingesp32.

IV. PROPOSEDTECHNIQUES

A target image indicates an image that the Vuforiaengine can access and track. The engine recognizes andtracksimagesbycomparingnaturalfeaturesextractedfro m camera images with known guided websites. Oncean image target is detected, the Vuforia Engine tracks theimageandeasilyaddscontentusingmarketimagetracking technology. A target image specifies an imagethat the Vuforia engine can access and track. The enginerecognizesandtracksimagesbycomparingnaturalfeat uresextractedfromcameraimageswithknownguided websites. Once an image target is detected, theVuforia engine tracks the image and easily adds contentusing marketimage trackingtechnology.

Visual buttons provide a convenient way to createtargeted images based on images. Use OnButtonPressedand OnButtonrelease to manage events when the buttonappears to be stuck to the camera. When creating displaybuttons,sizeandplacementshouldbecarefullyconsid eredinrelationtouserinformation.Therareseveralfeaturesth ataffecttheresponsivenessandusability of visual buttons. Augmented Reality (AR) is anewtechnologythatalreadyhaspotentialforuseineducation. Most of the research has been done on AR, butthere is also some research done in education. In recentyears, the use of this technology has increased the numberofARcourses[6].

- Buttonlengthand width.
- Thelocationofthetargetthat itcovers.
- Theplacementofabuttonrelativetoboththeimagebord er,and theother buttonsto thetarget.
- Thebottomofthebuttonhasahighbrightnessanddetailt omake theeventeasier.

Amulti-targetisacollectionofmulti-imagetargets united into a geometric arrangement defined as abox. This enables tracking and discovery from all sides andcan serve multiple use cases such as marketing packagingandeducationalcontexts.Startcreatingamulti-targetVuforiatargetmanageranduploadamulti-targetsize

image.2Dimagescanbeusedtocreateaugmentedormixed reality. The advantage of this approach is that oneimage is enough for one object and the image is easy tocreate, so no complex or sophisticated tools or devices arerequired. A mobile device is all that is required to developand use the application. System expansion is also possiblewithoutproblems.However,usingimagesalso hasitsdrawbacks. Also, similar to QR codes, the mobile devicemust be close enough to the object when recognizing theobject, and the mobile device must be parallel to the imageoratthesameangleaswhentheimagewascreated.

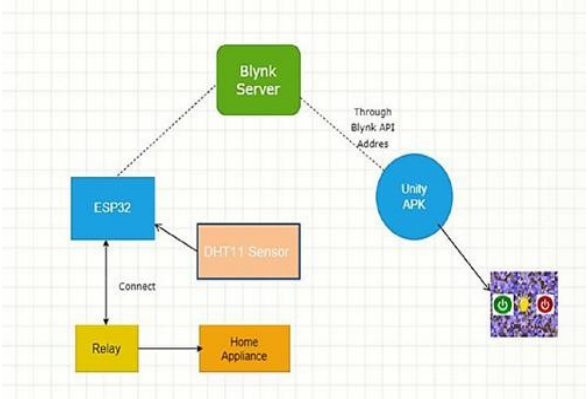


Fig.6.:Unity3dModelDesign

ConnectBlynkAppto Wi-fiModule(ESP8266)

Download the Blynk app from the Google Play Storeand sign up. Press the + icon at the top to create a newproject. I gave the project a name. To connect like WiFi,select"Device"as"ArduinoUNOType"andclick"Create".Aftercreatinganauthentiationtoken,theauthentication token will be sent to your registered emailaddress. You can also send it later in the Project Settingspage (groove icon) -> Devices. To add a button, press +and select the button. Clickthenewly created button toedit it. Give it a name and set the PIN digit to Digital D13.Changethemode to CHANGE.

ExtractAPKfromUnity

InstallingAndroidBuildSupportallowsyoutochangeyour project's build platform toAndroid. To dothis, go to File > Create Configuration and select AndroidArena. Then click the Change Field button. Change BuildPlatformUnityIfyoudon'tseetheChangePlatformbutton,yourbuildplatformisalreadysettoAndroid. Creating the APK File Once the platform is switched toAndroid, the Change Fields button should be replaced withthe Create button. Then download and install the APK onyourphone.

ProposedSystemDesign

Thefollowingfeaturesareusedinourproposedsystem

1. TostandardizeIOTandAR/MRinOurday-to-daylife.
2. TooperateaapplianceusingVirtualReality.
3. Tooperateanydevicewhichisworkingonelectricitywiththehelp smallelectronicscircuiti.e. IOT
4. Tosecurethesystembyallowingonlyauthoriseduserstoaccessthe device.

APK files developed on Unity Hub are saved as multi-target APK files. This APK file will be installed on yourphone and when opened on an image target you will see avirtual switch on the image target. These are used for ONdiagrams and OFF Figure 6 is displayed for target 1. APKfiles developed on Unity Hub are saved as multi-targetAPK files. This APK file will be installed on your phoneand when opened on an image target you will see a virtualswitchontheimagetarget.TheseareusedforONdiagrams and OUT Figure 6 is shown for target 1. TheMultiple Targets appdisplaysvirtual On andOff buttonsas shown in Figure 6. This will only appear if the app's ARcameradetectsanimageofTarget2.Thetargetimageused isshowninFigure 6.

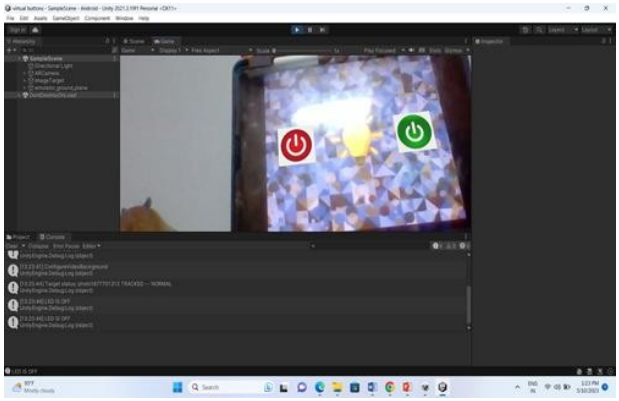


Fig.7:VirtualButtonsofAndroidApplication

The Advantages of Control and Monitoring of IoTDevices

Nowit'seasytofindtheinformationyouneedinrealtimefrom(almost)anywhere.Allyouneedisasmartdeviceandaninternetconnection.Homeautomationsystemshavecertainlymadetheirmark in theareaofenergysavings.Automaticthermostatletsyoupresettemperaturesbasedontimeofdayanddayofweek.Actualenergysavingsultimatelydependonthetypeofdeviceselectedanditsdefaultperformance.However,onaverage,themanufacturerestimatesthatthesystemsavestheconsumer10-15%onheatingandcoolingcosts.Anotherkeysellingpointofhomeautomationdevicesisluxury,whichvirtuallyeliminatesminorannoyancesliketurningoffthelightsbeforebedorsettingthethermostatwhenyouwakeupinthemorning.Manysystemshaveremotepoweronthedashboardsoyoudon'thavetodrivehomeifyouforgettoturnoffyourcoffeepotbeforeyouleave.Simplydragthedashboardontoyoursmartdeviceorcomputerandturnoffyourcoffeepotinseconds.Remotemonitoringmakesyoufeelmorecomfortableonthego.

V. CONCLUSION

AnIoTsystemthatcombineshomeappliancesindividually.Someofthemethodsavailableforhomeautomationworkwith flexibleconstructioncontrolsforhousehold tasks such as televisions, fans, power pipes, andrefrigerators. After reading and understanding the literaturereview and other available activities, we suggest strategiesto help you better understand the natural conditions of yourhome. It also notifies theuser of any errors that occur onthe device. In this article, we plan to eliminate most humaninteractionbyintroducinganintelligentsystem. DevelopmentofthisprogramwithInternetofThingstechnology . Through these programs, we are able to buildtruly low-cost smart homes, restore natural conditions, andenable flexible homes that correct mistakes through energysavings.

VI. FUTURESCOPE

One of the future challenges of home automation is tomake smart homes more efficient. Houses can be connectedtosensorssuchassensors,lightsensors,temperaturesensors,etc.,enablingdevice-basedautomaticswitching.Youcansaveevenmoreenergybyturningonyourappliances, checking the lights, and making sure your homeis floating before turning them off if necessary. The systemcanbetightlyintegratedwithhomesecuritysolutions,givinghomeownersmorecontroland security.

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