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Fire fighting Robot for Server Rooms

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Abstract: *Fire fighting is an essential but dangerous stask. A fire fighter must be able to get to a fire quickly and safely extinguis h the fire, preventing further damage and reduce causalities. Technology has finally bridged the gap between fire fighting and machines allowing for a more efficient and effective method of fire fighting. This paper discusses about a method for fire fighting in server rooms. The equipment inside server rooms is very costly, so that in accurate fire extinguishing techniques will result in huge economiclosses. The robot consists of a master and a slave. The master robot always checks the surrounding area. Upon receiving a fire signal from a flame sensor, master robot get sahigh in put signal and them as ter robot identifies the area of fire. After identifying the area ,the master robot navigates the slave robot towards the fire. At the same time the master robot transmits the fire signal to the fire station and security system. The simulation has been carried out and the results have been included in this paper.*

I. Introduction

Theadvancementinthescienceandtechnologyreducesthehumaneffortinagreatextent.Asapartof this,lotsofsubstitutionsweremadeforhumansespeciallyinsituationswhichthreaten humanlife.Firehazardsare suchasituationwhichisverydangerousfor humans whenitis outofcontrol.Robotsareintroducedinthis situation whichcaneffectivelyhandlethesituation. Theycaneffectively detectthefireandcontrolitwithminimum casualties.Themodeofextinguishing thefirevarieswiththecauseoffire.Inthepresentscenario,humansare directlyinvolvedtoextinguishthefire.Butwhenthesituationisverycritical,humanlifegetspoiled.Such situationsdemand thefirefightingrobotsinstead ofhumansbecause,humanlife isalways preciousthananythingin theworld.Ifwelosearobotinacriticalsituation, itdoesn'tmatter;wecangoforanotherone.Wecannot compromiseforahumanlife.Firefighting robotscanbeintroducedinindustriesaswellusinserverrooms.The operatingspeedofthefirefightingrobotisveryimportant.Operatingspeedis proportionaltothecasualtiesmadeby firehazards.

The proposedsystemconsists ofa stationandarobot.Whenthestationdetectsthefire, itsends commands tothefirefightingrobotregardingthelocation.Iftheintensityofthefireismore,thenthestationwillinformitto the nearfire station.Therobotwillmarchedtothetargetafterreceivingcommandsfromthestation.Then extinguishthefireandcomesbacktotheinitiallocation.Therobotmovementisbasedonthelinetrackingsystem.

Firefightingisimportanttoensurethesafetyofpeopleandtoavoidlossesinallfields.Arobottriggeredby the flame and navigate to the flame through a maze is a simple model of fire extinguishing robot. After extinguishing theflamerobotreturnstotheoriginalpositionavoidthecomplexityofprogramming thecontroller. Onelimitation isthattherobotshouldnavigatetowithin30cmoftheflame[1].Ifweuserobotshieldwhichhas calciumsilicatecoating,itenablestherobottowithstandhightemperature.Athermocouplecanbeusedtodetect thefire.Thethermocouple endshaveacutofftemperature beyondthattherobotstartstorespondtothefire. Amplifiedvoltagefromthermocouple canbeusedtorunthewaterpump.Theobjectiveofobstacleavoiderand motionsensoristocontroltherobot.Highdynamicrangecameraprovideshumanrecognition. Upondetecting humanrecognitionrobotalertstherescuerbyanalarm[2].Lackoftechnologicaladvancement infirefighting areais themaincauseofmanylosses.Additionofwirelesscameraandmaprepresentation viaBluetoothaidaneffective wayofexternalcommunication.The signal fromdigitalcompasspassedontotheMATLABvia Bluetoothprovides information aboutthecurrentpositionoftherobotonthepersonalcomputer. Theuseoffanstoextinguishthefire avoidstheproblemsassociatedwiththewaterleakage[3].Differentialdrivesystemavoidsthedifficultiesinrotati ofthemotors.Thedesignofmotordrivingcircuitrywithbipolarjunctiontransistorsand Pulsewidthmodulationisa greatmethodofcontrollingtheamountofpowerdeliveredtoaloadwithoutdissipatinganywastedpower.The mazenavigation algorithmtodrivetherobotinapreplannedpathavoidsconfusions abouttheobstacle[4]. The autonomousandsemiautonomous modeoftherobotallowshumantocontroltherobotonarequirement.The objective ofthemaster-slavemodeofoperation istoreducethecost.Theslaverobotdoesnothaveanyself-intelligence.Theabilityoftherobotstoworkasagroupimprovestheeffectiveness offirefighting[5].Anewfire extinguishingrobotisproposed,whichisemployedinaserverroom. Thedesignoftherobotissuch thattoreduce thecost.Therobottransferfiresignaltothe securitysystemand firestationwhenthefireisdetected.

Datacentersarethebackbone ofpresentworld'shighly engineeredsociety.Applicationssuchassocial media,cloud computing,onlinebanking,ande-healthcaresolutionsimpactour life everyday. Failureoftheinternal datacenterposesasignificant problemwithinashorttime.Formaximumprotection,afiresafetysystem isneeded toensurebusinesscontinuity, personalsafetyetc.Humanfailureortechnical reasoncanleadtofire.Soitis importanttoDesign theserverroomwithnecessaryFiredetectionsystem.Currentmeasuretakeninserverroom to preventfireisnotthatmucheffective.Therearetwoprimarytypesoffiresuppressionsystems,watersprinklers, andgaseousagentfiresuppression solution. Themajorproblemwithwatersprinklersisthattheycouldcause significantdamagetotheequipment.Sincewater isagood conductorofelectricitysmallshortcircuit maycausefor high fire disaster. Additionally, water sprinklers could accidentallybecome activated and cause unnecessary damage.Halongaseousagentisnolongerinproductionduetobeingahealthriskandenvironmentaldangerand alsoitisexpensive.This systemcan provideseffectiveandmoderatecostfire suppression.Therobotwilldetect the fireatthestartingstage,movetowardsthefireandextinguishesthefire.

II. Design

Thefireextinguishing robotconsistsofastationarymasterrobotandmanyslaverobots.Theslaverobots arecontrolledbythemaster.Theblockdiagramofthesystemisasshowninfig1.

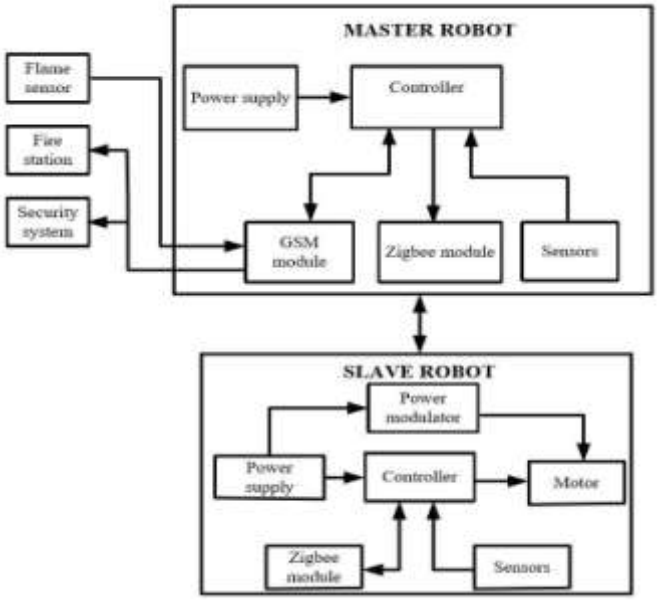

Fig. 1. BlockDiagram

Controlsystemofthis robotconsistsofamicrocontroller,whichisusedtosendandreceiveinformationto theslaverobots.ATmega16isselectedasthemicrocontroller. Itprovidesallthecontrolsignals.Firedetection system isusedtodetectfireattherighttime.Thefiredetectionsystem ismadeupofIRsensors.Zigbeemoduleis usedtofacilitatethecommunication betweenthemasterrobotandslaverobots.GSMmoduleisusedtogive emergencyalarmsignalstothesecuritysystemandfire station.Themotordrivingmoduleandlinefollowermodule are usedtocontrolthemovementoftherobotsinthedesireddirectioThemasterrobotcontinuously monitorsthevariationofthesurroundingareausingthesensors.Wheneverthe temperatureexceedsalimitvalueandflame isdetected,master robotidentifiesthat thereisapresenceoffire. Then theslaverobotmovesaccording tothedirectionsfromthemasterrobot.Whentheslaveidentifies thefirearea,the fireextinguisherisactuated.Theslave robot returnstotheoriginal positionafterextinguishingthefire.Whenafire hasoccurredthemastergivessignalstothefiremenandnearestfirestationthroughGSM.

III. Hardware Implementation

Powersupply: Thefireextinguishingrobothasapowersupplyfromthe12Vrechargeablebattery.Thebattery suppliespowertotheLM293Dmotordriver,microcontroller, andallthesensorsintherobot.Theselectionof differenttypesofbatterieswasmadebasedonsizeandpowerrequirements

Zigbeemodules: Zigbeeisalow-power,low-costwirelessmeshnetworktargetedatbattery-powered devicesin wireless controlandmonitoringapplications. Zigbeedeliverslow-latencycommunication.Itisusedtofacilitatethe communication betweenthemasterandslaverobot.Themasterrobotgivesinstructionstotheslaverobotthrough zigbeemodule.Theslaverobotmovesaccordingtothoseinstructions.

Flamesensor: Flamesensorsareusedtodetectthefire.Thefireextinguishingrobotautomatically detectsand extinguishesthefire.Theflamesensorsintheserverroominitially detect theflameandsendasignaltothemaster robotthrough GSMmodule.Using thissignalthemasterrobotidentifies theareaandnavigates theslaverobotsto thatarea.

GSMmodule: Thesignalsfromflamesensorsaretransferredtothemasterrobotthrough theGSMmodule.Also, thefirealertstothefirestationandsecuritysystemare giventhroughtheGSMmodule

Withdyslipidemiawereas follows

DCmotors: Thedrivemotors arepermanent magnetDCmotors,withamaxspeedof30RPMat12voltsusing8 cmdiameter wheels.

Motordrivermoduleandlinefollowermodule:L293Dmotordriverisusedtodrivethevehicle.Motordrivers actascurrentamplifiers.They amplifyalow-currentcontrolsignaltoprovideahigher-currentsignalwhichisused todrivethemotors.Initscommonmodeofoperation,twoDCmotorscanbedrivensimultaneously,bothinforward andreversedirection.The L293Disdesignedtoprovidecurrentsof upto600-mAatvoltagesfrom4.5Vto36V.

Thelinestobetrackedaremadeofblacktapepastedonawhitereflecting background arena.Weused InfraredLEDsandLDRsensorstosensetheblackline.Sincethelightfromemittercouldreflectfromthewhite areaandreachtheadjacentoptically isolateddetector,andcouldnotreachthedetectorduetothenon-reflecting surfaceoftheblackline,theblacklineandwhiteareacouldbedifferentiated.Whenasensorisabovethewhite area,lightisbeingdetectedbythedetectorconnectedtotheinterrupt pin ofthecontroller. However, assoonasthe sensorcomesabovetheblacklinecontrollerisinterruptedatonceandinvestigatedwhetheritissomedeviation or junction,andthecorrespondingactionistakenaccordingtothe situation.

IV. Software Implementation

Theentireoperationoftherobot canbedividedintotwophases

1)TheMasterrobotdetectsthefire.

2)TheMasterrobotnavigatestheslaverobottowardsthefireareaandextinguishesit.

Themasterrobotalwayschecksthesurroundingarea.Theremaybemanyflamesensorsintheserver room.Herewearecons idering fourflamesensors.Uponreceivingasignalfromaparticularflamesensor,master robotgetsahighinputsignalandthemasterrobotidentifies thearea,onreferencetothatflamesensor.After identifyingthearea,themaster robotnavigatestheslave robottowardsthatflamesensor.Herelinefollowerisused tocontrolthemotionoftheslaverobot.Thereisaspecifiedtemperatureintheserverroom.Ifthetemperature sensedbytheflamesensorisgreaterthanthespecifiedvaluethefireextinguisherisactivatedandfiresignali passedontothenearestfirestationandsecuritysystem.Theslaverobotreturntoitsoriginalpositionafterthefireis extinguished.

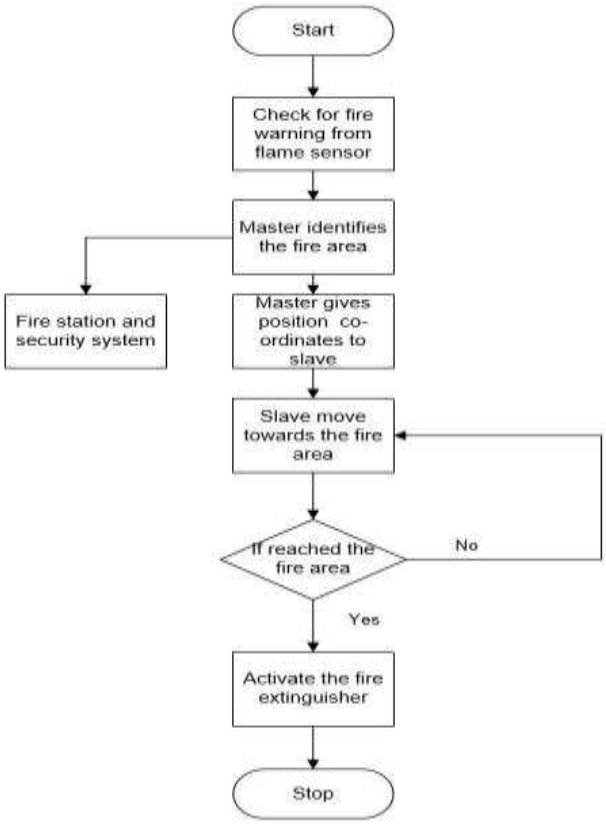

Fig. 2. Flowchart

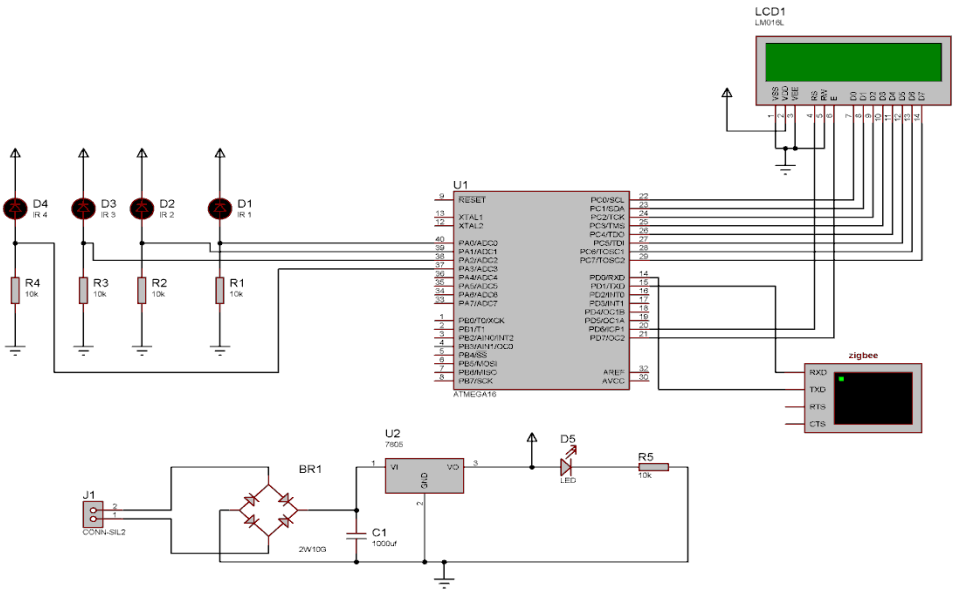

Fig. 3. Master

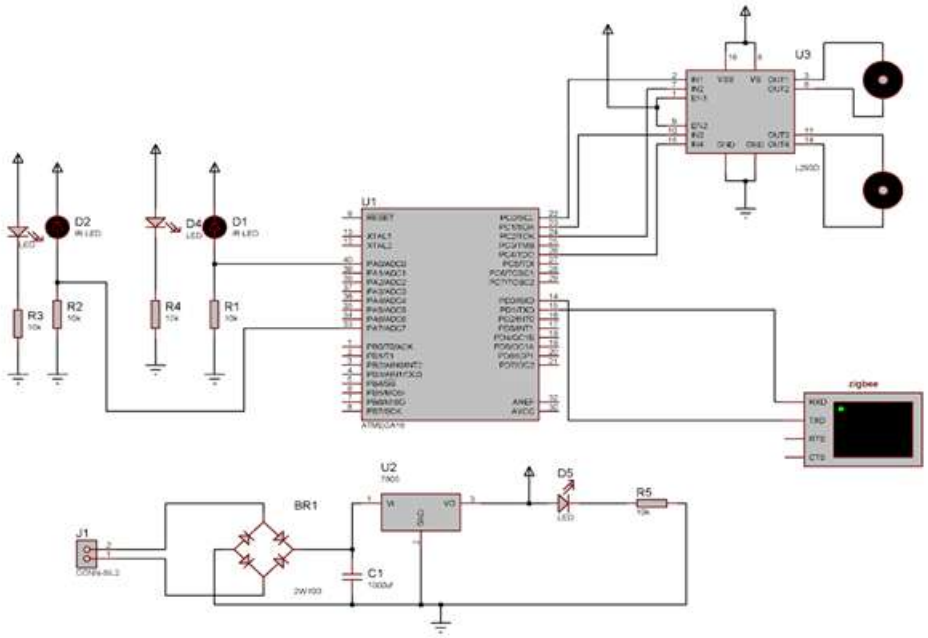

Fig. 4. Slave

V. Conclusion

Through the advancementof technologies,the robotics finds a crucial role in the firefighting.The substitution offirefighting robotsinsteadofhumanmakesadrasticchange,byreducingthecasualtiesaswellas savinghumanlife.Ourproposedpaperdemandstheimportanceofthefirefightingrobotsintheserver room.The masterslaveapproachmakesasmooth control offirewithintheserverrooms.Thesignalsfromthesensorsare detectedbythemaster.Thenavigationoftheslaverobotishandledbythemasterviaazigbeemodule.The firefighting robotaccuratelyandefficiently detectsthefireandextinguishesitintheserverroomwithina minimum intervaloftime.Theproposedpaperpointsanupdatedversionoffirefighting intheserverroomsina mostefficientway.

References

[1] D.J.Pack,R.Avanzato,D.J.Ahlgren,andI.M.Verner,"Fire-fightingmobileroboticsandinterdisciplinarydesign-comparative perspectives,"IEEETransactions onEducation,vol.47,no. 3,pp.369–376,Aug 2004.
[2] B. S. Sampath, "Automatic fire extinguisher robot," in 2011 8th International Conference on Ubiquitous Robots and Ambient
[3] Intelligence (URAI),Nov 2011, pp. 215–218
[4] A.Hassanein,M.Elhawary,N.Jaber,andM.El-Abd,"Anautonomousfirefightingrobot,"072015 K.Altaf,A.Akbar,andB.Ijaz,"Designandconstructionofanautonomousfirefightingrobot,"in2007InternationalConferenceon InformationandEmerging Technologies,July2007,pp.1–
[5] S.V.P.K.Maddukuri, U.K.Renduchintala,A.Visvakumar,C.Pang,andS.K.Mittapally,"A low costsensorbasedautonomousand semi-autonomousfire-fightingsquadrobot,"in2016Sixth InternationalSymposiumonEmbeddedComputingandSystemDesign (ISED),Dec 2016, pp. 279–283