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DIGITAL IMAGE WATERMARKING USING THREE LEVELDISCRETE WAVELET TRANSFORM

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Abstract-Inthispaper,proposedareversibleimagewatermarking method basedoncontrastmapping.Thisalgorithmaccomplishestransformappliedonpixelsandtheirleastsignificantbitsareusedfordataembedding.Itisinvertibleiftheleastsignificantbitsofthetransformedpixelsarelostduringdataembedding.Reversiblecontrastmappingoffershighembeddingdataatlowvisualdistortion.Distortioncausedduetoembeddingshouldbemadesmall.Thisnecessaryapplicationslikemilitarynotional,rhetorical lawandmedicalnotional,distortionwithintheoriginalsignalmightcausefatalresults.Forinstance,atinylowdistortioninanexceedinglymedicalimagemightinterferewiththeaccuracy ofdocumentidentification.Distortionissueswhichcanariseinanexceedingly.Applications willbefastenedinareversiblelead totheoriginalandthewatermarkedimagewatermarkingtechnique.Reversibleimageequivalentsothatembeddeddataremainsimperceptibleonvisualization.Thesetypeofimperceptibledistortionisnotacceptableinmedicalandmilitaryimage.Thishasledtoaninterestonreversiblewatermarking,wheretheembeddedwatermarkisnotonlyextractedbutalsoperfectrestorationoftheoriginalsignalispossiblefromthewatermarkedimage.Lowcomputationcostandeaseofsemicustommakeitattractiveforrealtimeimplementationwatermarkingalgorithmscanbedividedintofivegroups.Losslesscompressionbasedalgorithms,differenceexpansionbasedalgorithms,andhistogramshiftingbasedalgorithms,predictionerrorexpansionbasedalgorithmsandintegertointegertransformbasedalgorithms.Performanceofawatermarkingalgorithmiscategorizedintothreeparts.Theyarevisualquality,payloadcapacityand computationalcomplexity.

Keywords-Reversibleimagewatermarking a hardwareimplementationcanbe reversiblecontrastmapping,semicustom

I.Introduction

Digitalwatermarkingisexpressedasaknowledgeconcealingtechniquethatisdevelopedforfunctionslikeidentification,copyrightprotectionandclassificationofdigitalmediacontent.Duringthistechnique,asecretinformationreferredtoaswatermarkisembeddedintothedigitaltransmissioncontentwithin thedecoder,watermarkinformationisextractedfromthewatermarkedsignalinanexceedinglylosslessmannerthoughoriginalsignalcan'tbeobtaineddesignedonafieldprogrammablegatearrayboardorcustomintegratedcircuit.Thedifferencebetween FPGAandcustomICimplementationisatrade-off amongthecost,powerconsumptionandperformance.HardwareimplementationusingFPGAhasadvantagesoflowinvestment cost,simplerdesigncycle,fieldprogrammabilityanddesktoptestingwithmediumprocessingspeed.Ontheotherside,duetolowerunitcost,fullcustom capabilityandfromanintegrationpoint,customimplementationapplicationspecificintegratedcircuitdesignmaybemoreuseful.Duringpastyears,FPGAswereselectedprimarilyforlowerspeed,complexity,volumedesigns,buttoday'sFPGAscaneasilypushuptothe500MHzperformancebarrier.

Aliteraturesurveyissurvivedforvariouspaperswhichareimportanttoknowthepreviouslyavailable techniques and their advantages andlimitations.Italsoincludesthevarioussupportingpapersfortheproposedtechniqueandtheiradvantages.Therearemanytechniquesavailableforreversibleimagewatermarking.Thereversiblecontrastmappingmethodprovidestoembedand pixelsuntilnounsampledpixelisleft.Afterthat,theremainingofthewatermarkbitsareinsertedintothesampledpixels,whichareinterpolatedusingnearbywatermarkedpixels.Thisschemeprovideslowembeddingdistortionandlesscomputationalcost,whichresultingoodimagequalityandefficientalgorithm. But thepixelshavingvalue0or255areunconsideredforextractthe watermarking.Thedataofsecretlyembeddinginordertopreventhidingandcommunicatinginformationhasgainedimmenseimportanceinthetwodecadesduetotheadvantagesingeneration,storage,andCommunicationtechnologyofdigitalcontent.Watermarkingissolutionsfortamperdetectionandprotectionofdigitalcontent.Watermarking cancausedamagetotheinformationpresentinthecoverwork. Atthereceivingend,theexactreconstructionoftheworkmaynotbepossible.Inadditionthereexistcertainapplicationsthatmaynotpassevensmalldistortionsinreportworkprioritytothedownstreamtechniques.Inthatapplications,reversiblewatermarkinginsteadofotherwatermarkingisoccupied.Reversible watermarkingofdigitalimageallowsfullextractionofthewatermarkalongwiththecompletereconstructionofthecoverwork. Inpastyears,reversiblewatermarkingprocessaregainingpopularitybecauseofitsincreasingapplicationsinimportantandsensitiveareas,i.e.,militaryinformation,healthcare,andlaw-enforcement.Duetotherapidevolutionofreversiblewatermarkingprocess,alatestsurveyofrecentresearchinthisfieldishighlydesirable.

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In2001,Honsingeretalwasintroducedoneofthefirst reversiblewatermarkingmethod.Theyutilizedmoduloaddit iontoachievereversibilityintheirwatermarkingprocess.Ma cqdevelopedareversiblewatermarkingapproachbymodifyi ngthepatchworkalgorithmandusedmoduloaddition.Althoug h,proposedreversibletechniquesaretheimperceptibilityofthe irapproachesisnotmagnificent.Thewatermarkedimagesresul tingfromthesetechniquescan‘ttoleratefromsaltandpeppernoi seduetotheuseofmoduloaddition.Areversiblewatermarking techniquewithoutusingmoduloadditionwasthenintroduced byproposedtheconceptofcompressingtheleastsignificantbitp laneofcoverimagetomakespaceforthewatermarktobeembe dded.In2013Luoetalreportedareversiblewatermarkingmet hodusinginterpolationtechnique.

Thewatermarkbitsareembeddedintheunsampledover flow/underflow. Correlationbetweenadjacentpixelsisefficientlyuncorrelated withinterpolationprocess.Embeddingcapacityisimprovedby adaptiveembeddingalgorithm.Pixelselectionprocessisutili zedtoobtaingoodvisualquality.Interpolationvalueisestima tedbyusingenclosingpixelstoobtainbetterprediction.Structur alsimilarityindexisanothermetricwhichmeasuresthesimila ritybetweendifferentimages.

II.ReversibleContrastMappingAlgorithm

Let(x,y)bethevaluesofpixelpairinanimage,thenthepi xelintensityvaluesareboundedbetween[0,255]foran8-bitsorpixelgrayscaleimage.Theforwardintegertransformf orapairofpixelvaluesisdefined.Topreventtheoverloadandth eunderloadproblem,thetransformpairisrestrictedwithinas ub-domain.Theinversetransformationcanperfectlyrestoredthepi xelpairvalueseveniftheleastsignificantbitsofthetransformed pixelpairsarelost,exceptwhenbothpairofpixelsareoddsetof values.Theoccurrenceofoddpairofpixelsisexpectedtobel owwithrespecttothetotalpossibilityofoccurrenceofotherco mbinations,hencealargesetofpairofpixelsmaybeavailablef ordataembedding.Sothatreversiblecontrastmapping provides highembeddingbitrateandthisisachievedataverylo wmathematicalcomplexity.Highpayloadembeddingthrough passingmoredatainsertionintroducedmanyvisualdistortions. Distortioncontrolisneededtoreducerecognizeddegradation. Astraightforwardattempttocontrolsuchdistortionistotransfor mpairofpixelvaluesonlyiftheydonotexceedapredefinederr orthreshold ordistortionthreshold.

III.WatermarkEmbedding

Torealizereversiblecontrastmappingalgorithm,theo riginalimageispartitionedintononoverlappinggroupsofpixel spairsfollowingeitherhorizontallyorvertically,likeanyspacef illingcurve.Aimofthisworkistodevelopsemicustom,theorigi nalimageispartitionedinto8×8or32×32non-overlappingblockofpixels.Lateroneachblockispartitionedint opairsofpixelvalues.

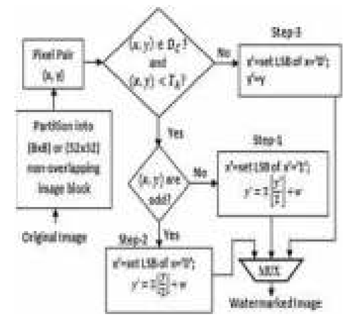

Fig1.Dataflowdiagramofwatermarkembedding

- Read cover image
- Read watermark image
- Partition watermark image into 32x32 blocks
- Partition watermark image into 32x16 blocks
- Mapping
- Divide pixel pairs into different sets
- Initialize various index values
- Set S1 contains all pixels that satisfy the difference value condition
- Set S2 contains all expandable pixel pairs thatare not in S1
- Set S21 contains all pixel pairs whose difference value is less than threshold
- Set S22 contains all pixel pairs whose difference value is greater than threshold
- Set S3 contains all changeable pixel pairs embedding is performed in set S3

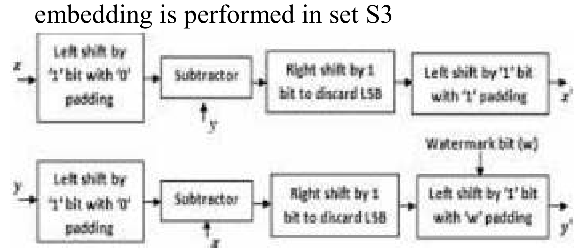

Fig2.Datapathforstep-1ofwatermarkembedding

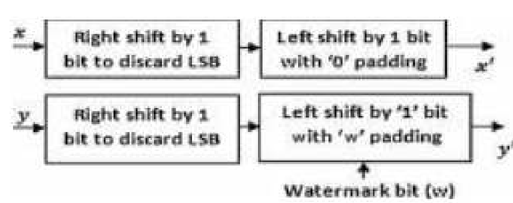

Fig3.Datapathforstep-2ofwatermarkembedding

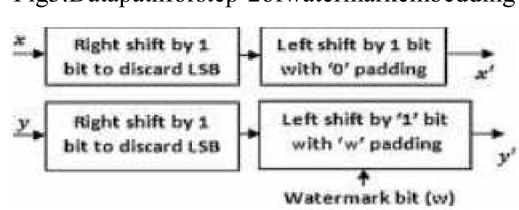

Fig4.Datapathforstep-3ofwatermarkembedding

Fig2indicatesthattheresultantvalueisleftshiftedby 1bitwith1padding.Similarlythewatermarkbitisembeddedi ntotheLSBofy.Fig3indicatestheStep-2operationofwatermarkembedding,whereLSBofxismade0b ytwoconsecutiveshiftingoperations.Thevalueofxisfirstri ghtshiftedby1bittodiscarditsLSB,then1bitleftshiftingope rationwith0paddingisperformedtogeneratethefinalresult.I nthesimilarwaywatermarkdataisembeddedintotheLSBof y.Fig4indicatesthatStep-3,isthesimplestamongthethree.

IV.WatermarkExtraction

Thestepsaresimilarasinwatermarkembeddingprocess .Herethewatermarkedimageispartitionedintosmallerblocksi zeof8×8or32×32andeachblockisagainpartitionedintopair sofpixelsandusinghorizontalpartitioningmethodasusedine mbedding.Themarkedimageispartitionedagainintopairsofpi xels.Thenanyonestepisfollowedsubjecttotwodifferentcondit ionscheckas.Theprocessisrepeateduntilitcoversallthepixelp airs.Thefollowingstepsrepresentsthewatermarkextraction processandrecoveryoftheoriginal/hostimage.

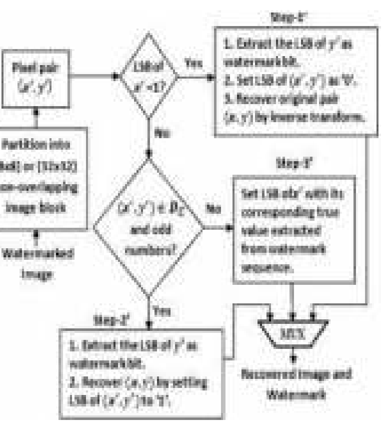

Fig5.Dataflowdiagramofwatermark extraction

- Load stego image
- Partition watermark image into 32x32 blocks
- Divide pixel pairs into different sets initializevarious index values
- Set S1 contains all pixel pairs that satisfy the difference value condition
- Set S2 contains all expandable pixel pairs that are not in S1
- Set S21 contains all pixel pairs whosedifference value is less than threshold
- Set S22 contains all pixel pairs whosedifference value is greater than threshold
- Set S3 contains all changeable pixel pairs embedding is performed in set S3
- Set S4 contains all non-changeable pixel pairs etermine size of watermarked image in Height and Weight
- Use LSB of watermarked image to recover.

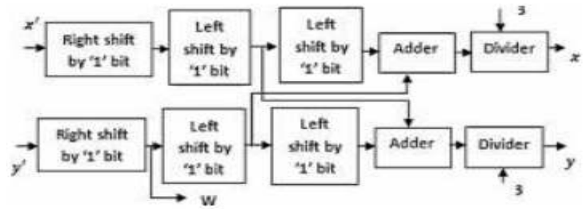

Fig6.Datapathforstep-1ofwatermarkextraction

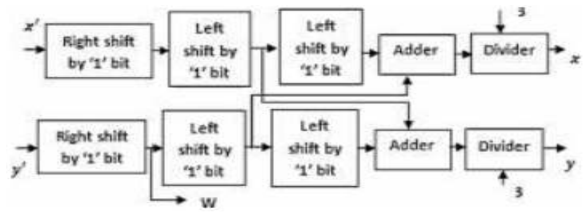

Fig7.Datapathforstep-2ofwatermark extraction

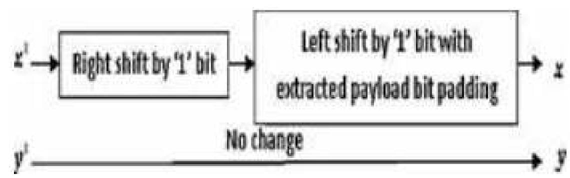

Fig8.Datapathforstep-3ofwatermark extraction

Fig6.Illustratesthatinstep1forwatermarkextraction,th einputisgivenasx1.Thenitisleftshiftedby1bitfor2timesandi tisaddedwiththevaluew,dividedby3andtheoutputwillbex.sa meprocessrepeatedfory1.Fig7illustratesthatinstep2forwate rmarkextraction,theinputisgivenasx1,anditisrightshiftedby 1bitandtheleftshiftedby1bitwith1padding.Theoutputwillbe sameprocessisrepeatedforyandLSBalsoextracted.Fig8ill ustratesthatinstep3forwatermarkextraction,theinputisgiv enasx1anditisrightshiftedby1bitandleftshiftedby1bitwithex tractedpayloadbitpaddingandtheoutputwillbex.Nexty1isgiv enasinputwithoutchangetheoutputwillbey.

V.HDLCoder

Ahardwaredescriptionlanguageenablesaprecise,for maldescriptionofanelectroniccircuitthatallowsfortheautom atedanalysis,simulation,andsimulatedtestingofanelectronic circuit.ItalsoallowsforthecompilationofanHDLprograminto alowerlevelspecificationofphysicalelectroniccomponent s,suchasthesetofmasksusedtocreateanintegratedcircuit. TheHDLWorkflowAdvisorinHDLCoderautomaticallyco nvertsMATLABcodefromfloating-pointtofixed-pointandgeneratessynthesizableVHDLandVerilogcode.T hiscapabilityletsmodelthealgorithmatahighlevelusingabst ractMATLABconstructsandSystemobjectswhileprovidingo ptionsforgeneratingHDLcodethatisoptimizedforhardwarei mplementation.

VI.ResultsAndDiscussion


Fig9.InputimageFig10.SecretImage

Fig11.Watermarkedimagecontainssecretimage

Fig12.Stegoimage

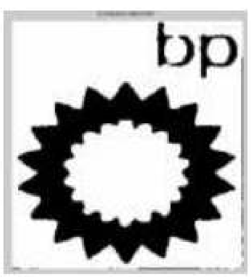

Fig13.Extractedwater mark

Fig14.SemicustomLayout

Fig13illustratesthattheinputimage,Fig10illustratesthatsecretimage,Fig11illustratesthatwatermarkimagecontainssecretimage,Fig12illustratesthatstegoimage,Fig13illustratesthatextractedwatermark,Fig14illustratesthatsemicustomlayout. AftergeneratingHDLcode,netlistiscreated.Byusingnetlist,semicustomisimplementedinmentorgraphics.

VII.Conclusion

Thepixelvaluesmarkedbyrectangularblockindicateaparticularcasewherethosepixelvaluesarenotconsideredforembeddingoperations.SoneedtostoretheirLSBsofxasasideinformationoroverheadinformation.Ontheotherhand,fortherestofthepixelvalues,neednothavetostorethecorrespondingLSB valuesofx.Thisismarkedby_X‘.Theareainsemicustomlayoutis2.85nm.

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