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Autovisionconveyorbeltmechanismusingscilab

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Abstract:*Inmanyindustrialapplications,automationofcolorbasedsortinginrawmaterialsistheneedofhourtooptimizeresourcesandsavetime.Theaimofthispaperistominimizethesubjectiveerrorsofvisualinspection.Thesystemisdevelopedforsortingoffoodmaterialsbasedonthresholdinginimageprocessing.Theimageoffoodmaterialwillbecapturedby aUSBCameraandimageprocessingwillbecarriedoutinSCILAB softwareformoreaccurateresults.OncetheimageprocessingiscompletetheresultswillfurtherbedisplayedonthescreenandaccordingtotheresultobtainedtheMicrocontrollerwillcarryoutthesortingmechanism.Forsortingpurpose,weusethepushingmechanisminterfacedwiththeMicrocontrollercircuitry.Thispaperproposesthesystemforanautovisionfoodindustryusing SCILAB softwareforhigherspeedandaccuracy.*

Keywords–*Conveyerbelt,IRsensors,camera,SCILAB,CIELABcolorspace,Microcontroller.*

I. Introduction

Indiaisanagriculturalcountry,havinghugerevenuefromitsfoodindustry.Howeverduetoshortcomingsinthetraditionalmethodsofsortingtherawmaterialswemayfacelosses.Usinganautovisioninspectiontechnology,wecanensurehigherspeedandaccuracy.Thefoodqualitydetectionhelpsintheestimationofshelflifeofthefoodmaterialsensuringlesserwastageofresources.Also,manyfoodmaterialsareexportedfromIndiawhichrequiresthesortingoffoodmaterialsintogradesdependinguponthesize,shapeorcolor.Thisseparationisdonebasedonthelocalandtheinternationalneedswhichcanbeimplementedusingimagesegmentation.Variousfoodpackagingindustriesalsorequireafinalcheckonthepackagedfoodproductstoensure proper transportationoffood materials.All thesequalitychecksmayrequire significant amountoftimeandefforts,howeverusingvarioustechnologieswecanprovideautomationforthesame.Thispaperproposesonesuchmethodfortheclassificationoffoodmaterials.

Thisfoodqualitymanagementsystemisbasedontheextractionofthefeaturesofrawmaterialandsortingthemdependingonthecolorbasedthresholdingforthematurationanalysis.Thedetectingalgorithmisbasedon IRsensors.Onceth ematerialisdetectedby theIRsensors,theconveyorbeltinterfacedwiththemicrocontroller(8051)willstop and the USB camerawillcaptureimage.Theimagecapturedwillhaveatleastoneviewofthefoodmaterialwhichwillbefurtherprovidedtothe PCforSCILABprocessingoftheimage.WewillusetheImageProcessingandDesigningtoolkit(IPD8.0),ithelpsusindetectionoftheobjects. AlongwithScilab image andvideoprocessingtoolboxfor realtime image andvideo analysis wecanperformvariousmathematicalfunctionsontheimages.

II. Literature Survey

HongsheDang,etal,intheirresearchpapertitled,"Human-MachineSystemsandCybernetics"proposedaFruitSizeDetectingandGradingSystemBasedonImagProcessing.Thepaperpresentstherecentdevelopmentsofimageprocessingandmachinevisionsystemin an automatedfruit quality measurement system.Objective of this paperistoemphasize on recentwork reportedonanautomaticfruitqualitydetectionsystem.Thispaperpresentstheimageprocessingtechniquesforfeatureextractionandclassificationforfruitqualitymeasurementsystem.

JohnB.Njoroge,etal,intheirresearchpapertitled"DesignandDevelopmentofaFullyAutomated Consumer-basedWirelessCommunicationSystemforFruitGradingISCIT."havedevelopedanautomatedgradingsystemusingimageprocessingwherethefocusisonthefruit'sinternalandexternaldefects.The systemconsistsofCCDcameras.Theimagecouldbecapturedusingregulardigitalcamera.Imageprocessingisusedtoanalyzethefruit'sfeatures;size,color,shapeandthegradeisdeterminedbasedonthefeatures.Thedevelopedsystemisbuiltfromacombinationofadvanceddesigns,expertfabricationsandau

tomaticmechanicalcontrol.

NaoshiKondo,inhisresearchpaper,"FruitGradingRobot"proposedthattheconveyorisadvanced throughaviewingareaandthearticlesaresimultaneouslyrotatedsuchthatelectricalimagesare formedofeacharticlewithina viewingzonedefinedineachchannelduringagiventimeframe.

III. Proposed system

Theproposedsystemwillhavethemicrocontrollerastheheartofthesystemwiththeconveyorbelt,IRsensorsan dpushingmechanismallprogrammedforthedesignatedmechanism.

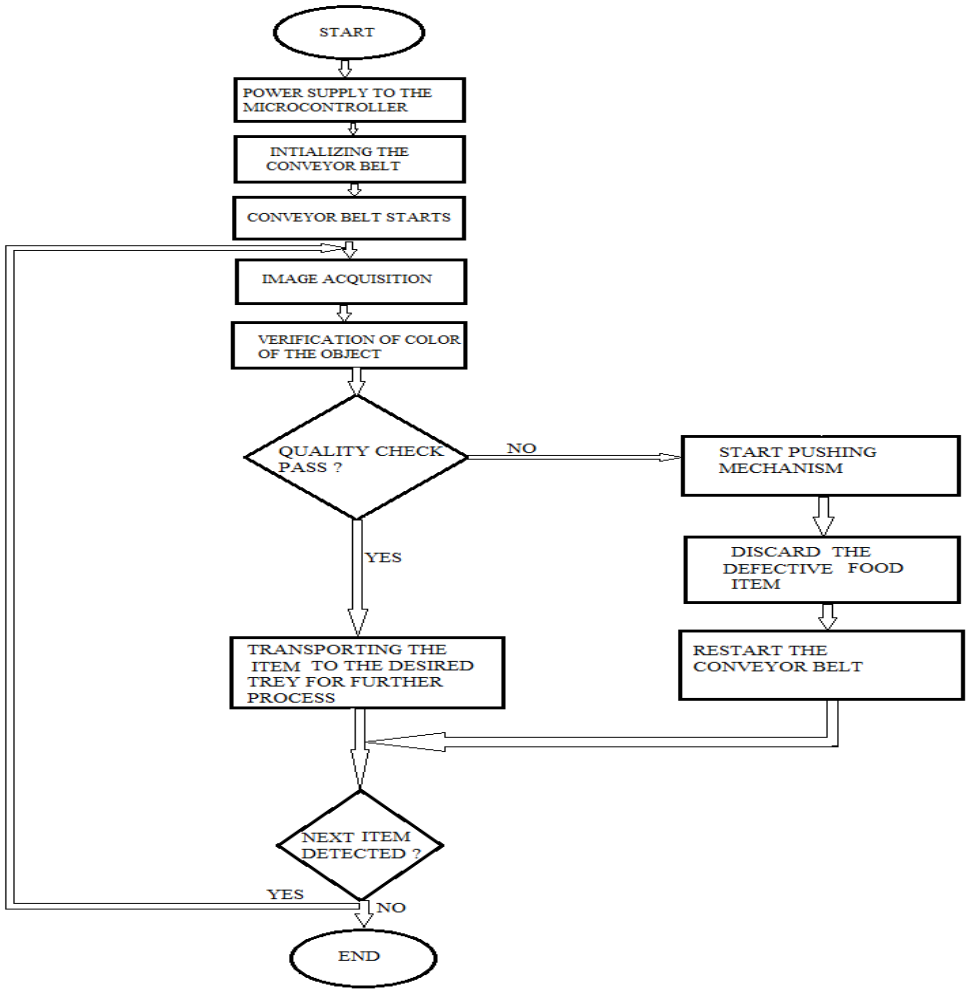

Fig.1: SortingMechanismFlowcha

IV. Hardware used

i CONVEYER BELT*ii*USBCAMERA*iii*IRSENSORS
iv MICROCONTROLLER UNIT

TheconveyerbeltiscontrolledusingtwoDCmotorshavingthemotordriveasL293D.Themotordrivewillwork at12Vandthespeedwillbestandard30rpm.Thepowersupplyprovidedtothesystemwillbekeptconstantat5Vfor maximumpowertransfertotheDCmotor drive.[1]

The reflectiveIR sensorsareplaced rightbefore theimagecapturingsection.Oncethe objectisdetected the IRsensorswillgiveahightolowsignaltothemicrocontroller.Themicrocontrollerwhichisinterfacedwiththemotordrive ofL293Dwillhavealogic(1,1)tostoptherotatingDCmotorstostoptheobject forperfectimageacquisition.Theconveyor belthastostopforbothimageacquisitionaswellpushingmechanismandthisisprogrammedusingthebasiclogictablefort heL293Dmotordrivetruthtable.

V. Software used

KieluvisionwillbeusedfortheprogrammingoftheAT89S52microcontroller.Wewillusetheumicrocontrolle

rFLASHMAGICsoftwaretoburnourlogicintothemicrocontrollerIC.SCILAB6.00alongwithImageProcessingandDesigning(IPD)toolboxwillbeusedforaccurateandfastimageoperation.Thecapturedimagewillundergograyscale thresholdingforcoloridentification.Foodproductqualitywillbedeterminedbasedontheimageattributes.[2]

VI. Image Processing

Thefirststageofimageprocessingisimageacquisitionwhichisdoneusingawebcamerainterfacedwithmicrocontroller
forrealtimeanalysis ofthefooditems.The illuminationoftheconveyorbeltsetupisappropriatelyadjustedaccordingtotheneedsofimageprocessing.Aftertheimageacquisitionprocess,thecapturedcolorimageisina2-

Dformatandhencetheimageanalysisisdonebasedonpixelconfiguration.Theconveyorbeltconsistsofblackcoloredstripandhencetheimageobtainedisa‘labelimage’,whichmeansthatthebackgroundpixelshavezerovalueandtheobjecthaspixelvalueshigherthanzero.Weperformthresholdingonthedigitalimagetoextracttheobjectsintheimage.[3][4]

Thegreyscaleconversionoftheobtainedimageistheinitialstageforthehistogramanalysisandhenceusingtheimageprocessinganddesigningtoolbox wesimplymakeuseofthebasictoolssuchas

```
-->Image= RGB2Gray(RGB)
-->figure();ShowColorImage;RGB_ColorImage;
-->figure;;ShoIlmage;Image_GrayLe|elImage;
```

Afterthegreyscaleconversion,wemakeuseofBlobanalysisfordetectingthebasicshapeofthefooditem.Blobanalysisworksontherelationshipsharedbetweentheneighbouringpixelsandcomparestherelativevaluesanddistinguishesthemastruepixels,everyfalsepixeliseliminatedandisassignedazerovalue.[5][6]

Thegreyscalehistogramcanbeobtainedforvariouscolorsinthedigitalimage,howeverweuseL*a*bCIELABcolorsystemforbetterimagecalculations.Thecolorchannelspresentintheimagearenormalized

consideringtheminimumvalueaszeroandmaximumvaluetobeone.Nowthehistogramcalculationsforredcolordependonthevaluesofboththechannels.IntheL*a*bcolorsystem,Lstandsforilluminationanditdependsuponthebackgroundoftheobject.Thebackgroundmaybecompletelywhiteorcompletelyblackdependinguponthehardwarespecifications ofconveyorbelt.HencevaluesofLrangefrom0to100where0representsblackand100yeildswhitecolor.Whereas ‘a’and‘b’representcolorvaluesoftheobjectincomparisontotheluminosityvalue(L).
Colorofthefoodmaterialcanbeeasilydetectedobservingthehistogrampeaksobtainedfrom SCILABsimulation.

Thuswecaneasilyobtainafaircolorclassificationusingthe L*a*bcolorspace.Anydigitalimageisanattributeofthreecolorsmainlyred-blue-

green(RGB)colorspace,howeverimagestorageisalsoanimportantaspectwhichmayaffectbothefficiencyandspeedofthesystem.UsingRBG565maylimitthememoryoccupancyupto 150kbs.[7]

VII. Pushing mechanism

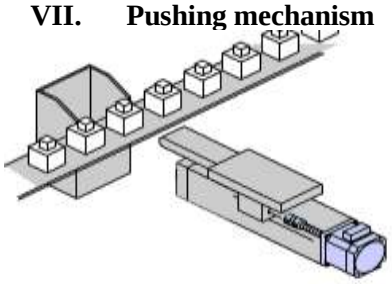

Fig. 2 Pushingmechanism forrejection of defectivefoodmaterials

Thelinearpushingmechanismwhichiscontrolledbythemicrocontrollerwillstartreceivingthepoweronlywhenthefoodmaterialisdefective.Thispushingmechanismisbasedonthe DCmotor,whichwillsimplydiscardthefruitfromtheconveyorbelt.ItisalinearlyactuatedDCmotorasshownintheFig.2.Thefoodmaterialwithnodefectswillbesimplepassedwithoutanyobstructiontowardsthedesiredassortments.[8]

VIII. Result

Fig.3.a: NormalizedL*

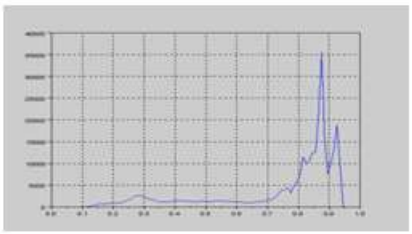

Fig.3.b: HistogramofNormalizedL*

Fig.4.a: Normalizeda*

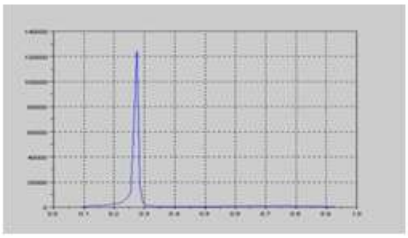

Fig.4.b: HistogramofNormalizeda*

Fig.5.a: Normalizedb*

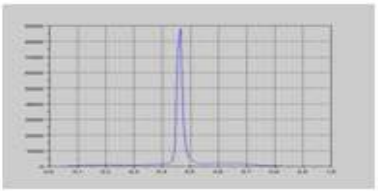

Fig.5.b: Histogramofnormalizedb*

TheaboveresultsareobtainedaftertheSCILABsimulationoftheimagecapturedthroughUSBcamera.Theoriginalimagecapturedbycameraundergoesgrayscalethresholdingforhistogramanalysis.Thecolorvaluesobtainedfromthe L*a*bcolorsystemaresubjectedtonormalizationandinversionafterwhichhistogramsaresimulatedbytheIPDtoolbox.

IX. Future Scope

Variousothersoftwarelikeopencomputervision3.4.0can beimplementedforbetterresults.Thusafterimplementationoftheabovealgorithm,futureworkwillfocusonthecreatinghighqualityvisual camerasformultivisionanalysisaswellasminimizationoftheembeddedsystem.Otheradvancementsmayinclude,usingthemulti.TheOpenComputerVisionsoftwareorMATLABsoftwarecanalsobeusedforfasterandmoreaccurateresults.Estimationoftheshelflifeofthefoodproductcanbeestimatedusingnon-invasivemoisturedetectiontechniques.Wecanalsouserubberrollersforconvenientrotationofthefoodproductratherthanusingaplainrubberbelt.

X. Conclusion

Theliteraturesurveyrevealsthatmanyinnovationshavebeenalreadynotedinthefieldofautomaticfoodmaterialgradingsystem.Herethesystemisorientedtoautomationforcolorbasedsortingoffoodmaterials.However,proposedsystemisademoversionandcanbeimplementedinlargescaleindustrieswhichcanyieldmoreprofit.Wecanusemultiplecamerasforbetterimageacquisition.Thespeedandlengthoftheconveyorbeltcanbefurthermodifiedbasedontheneedoftheindustry.Variousothertechnologiessuchasimplementationofrubberbasedrollerscanbeused,providingthemultipleanglesforbetterimageacquisition.Non-invasivemoisturedetectiontechniquecanbeusedfortheexactmoistureestimation.Thismaygivebetterideaabouttheshelflife.Hencewehavecompletedcolorsystemsimulationstageandtheresultsobtainedwereaccurateforrespectivecolors.Furtherimplementationofthehardwarewillbeexecutedaspertherequiredapplication.[9][10]

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