

Paper Defect Detection with Automatic Rejection Option Using Camera & Raspberry Pi

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Abstract: In Any Industry, Quality Control Is An Essential And Inevitable Part Of The Process. Defect Detection In Paper Is One Of The Most Important Quality Control Measures In The Paper Manufacturing Process. This Work Aims At Identifying The Spots And Tracking Down The Holes In The Paper. The Use Of Image Processing And Laser Sensor Is A Dominant Technology To Recognize Defect In The Paper. The Existing Methodology Is Based On The Scanning Slide Concept. This Uses A Scanning Slide And Detects The Black Spots As It Moves From One End To Another. The Main Drawback In This Technique Is That The Spots On One End Of The Paper Are Missed When The Scanner Is On The Other End. The Proposed Methodology Aims At A Fast And Precise Solution For Detection Of Defects. In This Method, Laser Sensors And High Definition Camera Are Introduced To Sense Micron Sized Spots And Minute Holes In The Paper. The Results Show A Considerable Improvement In Terms Of Precision And Speed When Compared To The Existing Methodology. This Work Is Successful In Detecting The Defects And Hence Improving The Quality Of Paper.

Keywords: Paper, Scanning Slide Concept, Camera, Black Spots, Raspberry Pi.

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I. INTRODUCTION

Paper Is A Material That Has Been Around For About 2000 Years. A Survey Of Over 1000 U.S And 500 U.K Consumers Asked Their Opinions On Variety Of Issues Surrounding Paper Based Vs. Digital Media. A Sizeable Majority Of 88% Of Respondents Indicated That They Understand, Retain And Use Information Better When They Read Prints On Paper, Compared To 64% Or Less When Reading On Electronic Devices^[3].

Quality Control Forms An Important Part Of Any Industry. Paper Manufacturing Industry Requires Its Final Product Viz. Paper To Be Of High Quality. The Most Important Quality Determining Factors Of The Paper Are Spots And Holes Present In It. A Quality Paper Should Be Free Of Any Spots And Holes^[3]. Various Ways Of The Detecting Defects In A Paper Have Been Discussed In Literature Over The Years.

Automatic Rejection System Is An Automation Technique Implemented In Most Of The Industries Where Production Is Of High Quantity. This Is Implemented To Give Defect Free Products To The Customers And To Remove The Defective Products Produced In An Industry. Automatic Rejection System Can Be Implemented On Any Product Based On Its Shape And Colour. It Uses The Concept Of Image Processing Using Matlab Software^[15]. In Traditional Methodology, The Product Is Manually Inspected And Had Disadvantages Such As Time Consuming, Inaccurate Results, High Cost Etc.

II. EXISTINGSYSTEM

The Existing Methodology Uses Scanning Slide Technology In The Detection Of Errors In The Paper. The Scanning Slide Is The Detector Introduced To Detect The Errors I.E., Black Spots In The Paper. This Slide Is Designed In Such A Way That The Scanner Moves Linearly From One End Of The Paper To The Other End. The Speed Of The Scanner Is Adjusted After Examining The Speed Of Movement Of The Paper. The Inconvenience Faced In This Methodology Is The Minute Sized Errors On One End Of The Paper Are Escaped When The Scanner Is On The Other End. The Quality Of The Product Is Reduced.

III. PROPOSEDSYSTEM

The Proposed Methodology Uses A Camera And Digital Image Processing To Detect The Pixel Change In The Paper From The Reference Paper. This Provides A Feasibility Evaluation Of Applying The Optical Inspection System To Provide High Quality Production. It Mainly Focuses On Micron Sized Error Reduction In The Paper. The Various Components Of The Proposed System Are Explained In The Following Section.

A. Conveyor System

A Conveyor System Is A Common Piece Of Mechanical Handling Equipment That Moves Materials From One Location To Another. Conveyors Are Especially Useful In Applications Involving The Transportation Of Heavy Or Bulky Materials. Conveyor Systems Allow Quick And Efficient Transportation For A Wide Variety Of Materials, Which Make Them Very Popular In The Material Handling And Packaging Industries. The Papers In Which Defects Are To Be Detected Are Placed On The Conveyor System. The Picture Of Conveyor System Used Is Shown In Fig.1.



Fig.1 Conveyor System

B. Webcam

A Webcam Is A Video Camera That Feeds Or Streams Its Image In Real Time To Or Through A Computer To A Computer Network. When Captured By The Computer, The Video Stream May Be Saved, Viewed Or Sent On To Other Networks Via Systems Such As The Internet, And Emailed As An Attachment. When Sent To A Remote Location, The Video Stream May Be Saved, Viewed Or On Sent There. Unlike An Ip Camera, A Webcam Is Generally Connected By A Usb Cable, Or Similar Cable, Or Built Into Computer Hardware, Such As Laptops.

In This Work, The Webcam Application Is Installed In The Mobile And It Is Used As The Camera System To Scan Papers. The Scanned Images Are Sent To The System. The Mobile Phone As Imaging System Is Illustrated In Fig.2.



Fig.2 Mobile Used As Webcam

C. Geared Motor

Geared Motor May Be An Ac Or Dc Motor Coupled With A Gearbox. The Additional Mechanical Gears Are Provided To Alter The Speed/ Torque Of The Motor. The Gear Assembly Helps In Increasing The Torque And Reducing The Speed. Using The Correct Combination Of Gears In A Gear Motor, Its Speed Can Be Adjusted To Any Desirable Unit.

In This Work, Geared Motor Is Used In This Work To Move The Conveyor At An Rpm Of 60 To12.

D. Raspberry Pi

The Allure Of The Raspberry Pi Comes From A Combination Of The Computer's Small Size And Affordable Price. Enthusiasts Envision Using The Small Form-Factor Pc As A Cheap Home Theatre Pc (Htpc), Or Secondary Low-Power Desktop. Institutions, Like Schools And Businesses, Could Benefit From Deploying A Fleet Of Computers For A Fraction Of The Cost Of Traditional Desktop Towers. The Small Size Makes For An Easy-To-Hide Computer That Sips Power And Can Be Mounted Behind The Display With An Appropriate Case. It Could Also Be Used In Niche Applications, Like Digital Signage. While It Will Not Blow Away Any Recent Hardware In Performance, It Does Make For A Cheap Secondary Computer Which Could Be Useful For

Troubleshooting And Researching Solutions If The Main Rig Fails To Boot As Well.

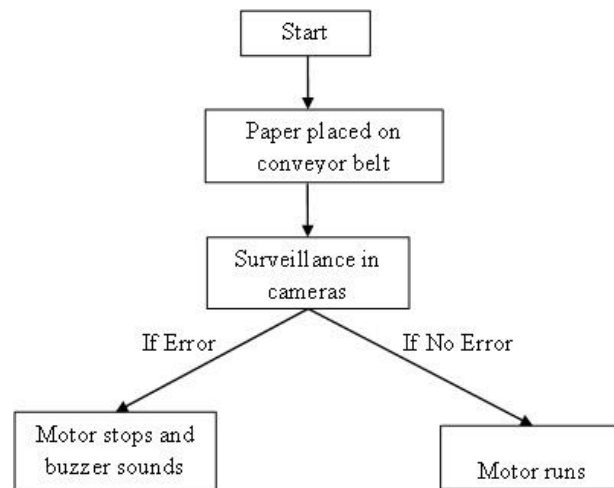
In This Work, Raspberry Pi Is Used To Interface The Ip Webcam With Raspberry Pi Server And Also Used To Control The Relay And Buzzer Circuit.

E. Relay

A Relay Is An Electrically Operated Two Way Switch. Many Relays Use An Electromagnet To Mechanically Operate A Switch, But Other Operating Principles Are Also Used, Such As Solid-State Relays. Relays Are Used Where It Is Necessary To Control A Circuit By A Separate Low-Power Signal, Or Where Several Circuits Must Be Controlled By One Signal.

In This Work, 5v Relay Is Used To Control The Motion Of The Belt. In Case Of Defect Detection The Relay Trips The Geared Motor.

iv. Implementation



When The Motor Is Turned On, The Conveyor Starts Running And The Paper Begins To Roll On The Conveyor. Midway On Top Of The Conveyor, A Camera Is Fixed On A Stand Arrangement. As The Paper Passes The Camera, Running Images Of The Paper Are Captured And Sent To The Raspberry Pi Controller. The Raspberry Pi Compares The Image Received From The Camera With The Standard Image In It. If There Is Any Error In The Paper (Black Spots Or Holes), The Controller Alarms The Buzzer And The Motor Stops. The Paper Is Then Pushed Into The Rejection Tray Using An Actuator Arrangement. In Case Of No Error, The Paper Passes Through The Camera And The Next Paper Is Checked For Errors And The Process Continues.

IV. RESULTS

A Sample Of 50 Papers With Black Spots Of Varying Sizes Was Supplied As Input To This System. The Observations Are Tabulated In Table.1.

Sample Size (No. Of Papers)	Spot Size	Successful Detection	Unsuccessful Detection	Success Rate (%)
50	5mm	50	0	100
50	4mm	50	0	100
50	3mm	50	0	100
50	2mm	50	0	100
50	< 2mm	0	50	0

Table.1. Spot Detection Results

V. CONCLUSION

It Was Observed That The System Was Extremely Successful In Detecting Spots Whose Size Exceeded 2 Mm. However The System Failed To Detect Spots In The Size Range Less Than 2 Mm. The Main Reason For This Being The Resolution Of Camera Chosen For This Work. If A High Resolution Camera Is Chosen, The System Can Be Made To Detect Spots Of Size Less Than 2 Mm.

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