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AN AUTOMATIC GRADING SYSTEM BASED ON MACHINE VISION

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I .INTRODUCTION

I.I Overview:

The concept is based on identifying the food on the basis of its color, shape size as well as the moisture content .This concept has been developed especially for the food items that we export . Color spectrum technique has been used here a numerous sensors have been developed for analyzing the other parameters of the food item.

I.II Objective:

This system is used to determine the various parameters of an onion meant for the export, and segregate them taking into consideration the required elements /factors that would meet the qualitative norms/criteria that has been fixed as per the export rules set by the government.

I.III Need:

Generally, we identify the food o the basis of its color, shape as well as size so we can use color spectrum technique. Color spectrum technique is an easy method to differentiate between various colors therefore we are going to design food separation system, which will separate different food particles based on their colors. The project is based on the fundamentals of optics and digital electronics

Today's world is the world of technology and science. Most of the things are automatic Due to automation life has become fast and easy. Onion is one of the most common consumed foods in the world. With the living standards of the human beings rapidly improving, large amount of onions with higher quality than before is needed nowadays. The quality of onion is based on a variety of properties such as texture, color , size, shape and moisture content. Onion quality inspection by humans (relying upon naked eyes) is neither objective nor efficient. Error increases sometimes due to inexperience or the inspection may be deliberately shifted out of sympathy for the producers. This kind of purely mechanical method is useless in recognizing and separating rice with different impurity but the same size. Most of the onion sorting machines available on the market are still based on the technologies of the 20th century, such as centralized control, and programmable logic device. Major shortcomings of such systems are 1) very simple functions, limited software adaptability whereas high design complexity 2) signal attenuation resulting from long distance transmission of the optical sensors output signal connected to the controller by long wire.

In the conventional onion sorter, image of fallen onion from a shoot is captured, and then onion is compared with some threshold value. If the parameter taken for analysis (color, moisture, wight, size, diameter) is below the threshold value, the onion is rejected as damaged one. This system has been developed taking into consideration the export rules that has been set by the Government for the export of the onion.

They Are:

1. No onions shall be exported unless graded and packed by a licensee demand
2. Any person who exports or attempts to export, or packs onions for export contrary to the provisions of this rule shall be guilty of an offence and shall be liable on summary conviction to a fine of two hundred dollars
3. The Minister may grant at his discretion to any suitable person, a license to grade and pack onions for export, and each licensee shall be allotted a registered number.
4 A licensee may not grade or pack onions except upon the premises specified in the license.
5 The Minister may, at his discretion, revoke any licence.
6 Every packing house shall be suitably equipped in every respect to the satisfaction of the Inspector or an officer of the Ministry for the grading and packing of onions. Packing houses must have sufficient floor areas allocated for storage purposes.
7. No onions shall be packed for export unless fully matured, properly dried, and in all other respects of good growth and condition.
8. Every licensee shall be entitled to make a charge for grading and packing onions and also for packages supplied

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to growers. Such charges shall be subject to the Minister's approval and shall not without the prior approval of the Minister be varied. Onions intended for export shall be conveyed to a packing house in standard field boxes or containers of similar design approved by the Inspector.

9 (1) The onions in any one package intended for export shall be uniform in size and grade.

(2) The following grades shall be recognized for purposes of export:

No. 1 Grade: 2 inches and larger diameter.
No. 2 Grade: 1 to 2 inches diameter.
No. 3 Grade: All onions under 1 inch diameter.

10. (1) All container packages containing onions for export shall be marked legibly and in plain letters on the outside with —

(a) the name or identification mark of shipper;
(b) the size of the onions in the package;
(c) the registered number of the licensee; and
(d) a label approved by the Minister indicating that

(2) Packages shall be marked and labelled under the supervision of an Inspector.

11. Every inspector is hereby authorized —

(a) to enter into licensed packing houses for inspection purposes at any time;

(b) to inspect all onions coming into any packing house and to condemn any onions packed or unpacked which in his opinion are unfit for export;

(c) to order any faulty package to be repacked and generally to supervise the grading and packing operations;

(d) to see that all packages intended for export are properly labelled and to satisfy himself that each and every package conforms to the required standard in every respect.

II. LITERATURE SURVEY:

Fig 2.1 Existing Onion sorter

III. SYSTEM ORGANIZATION

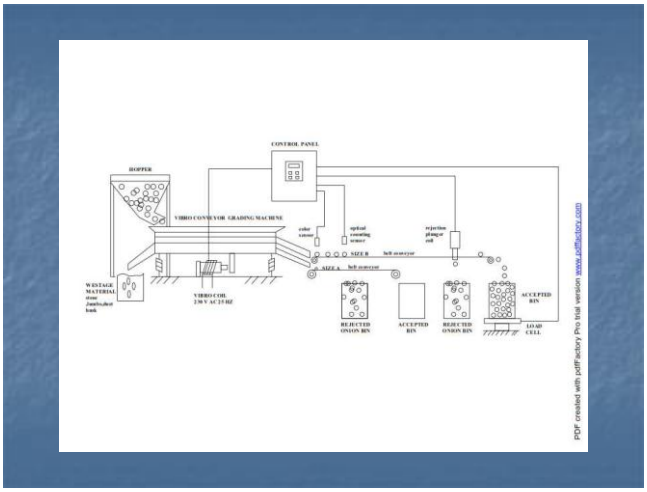

Fig2.2 Block Diagram

2

Parts of the system

The major components of the system are:

1.The belt conveyor
2.Vibro Conveyor
3.Vibro Coil
4.Seprator Tray
5.Color Sensor
6.Moisture sensor
7 PLC
8.Bins
9.Weighting Machine

III. MAJOR PROCEDURES TO BE CARRIED OUT ARE:

1.Sensing
2.Signal Conditioning
3.Detection & Display
4. Seperation
5. Loading & Weighting

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Rice and stone mixture is allowed to fall on electromagnetic vibrator. These images are captured by line scanner. Images are then processed and analyzed. A rice grains are stored in one pot while dust and stone particles are separated in another pot. Compressor and air gun system is used to throw the stones.

Sensing

1 There are three basic colors of light- Red Green and Blue.
2 In this system, we have to sense the colors.
3 Various sensors are available.
They are:
1. Photodiode.
2. Phototransistor.
3. LDRs.
4. Color Sensors
Out of which, we have used Color Sensors MTCIS in our system.

Light and color

This chapter is intended to be an introduction to the basics of light and color. The viewer is introduced to light as an electromagnetic quantity, and to the mechanisms by which light interacts with objects. The processes of producing colors by addition and subtraction of light are introduced. Then the concept of human color perception and color description is discussed. Finally the MTCIS is introduced and its function as a color detector is described. Light is a narrow range of electromagnetic energy, to which the human eye is sensitive. Electromagnetic energy travels in the form of waves, which can be described by their amplitude and frequency, or period. Normally light is described by its wavelength, in the units of nanometers (nm).

Light ranges from approximately 380nm to 780nm. Just outside this range lies ultraviolet (below 380nm) and infrared (above 780nm). Note that it is not proper to refer to ultraviolet and infrared radiation as light, since strictly speaking light is only radiation that we can see.

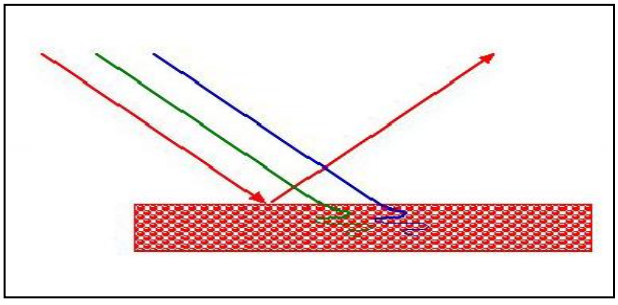

FIG 3.1 Spectral Power Radiation

Most sources used for illumination emit white, or nearly, white light. Vision occurs when light from surrounding objects reaches the Eye Light is both absorbed and reflected from object surfaces The amount of light reflected is different for each wavelength The wavelengths that are reflected from an object give the object its apparent color In this example, red light is reflected while blue and green are abs orbed – this object appears red Opaque surfaces do not pass light but rather reflect or absorb various wavelengths of light, sometimes in various degrees, as with colored surfaces.

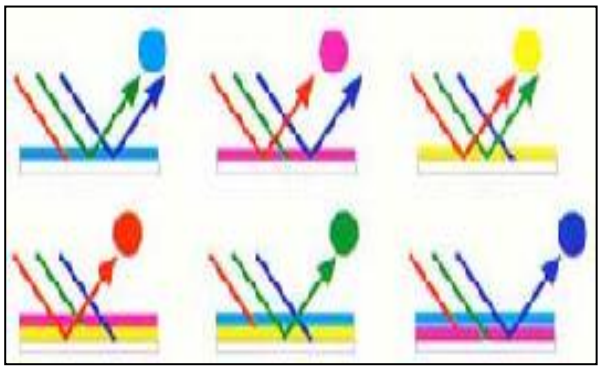

FIG 3.2 Addtive color mixing

These diagrams illustrate how a surface can create the perception of color by absorbing certain wavelengths while reflecting others. The chart shows that a blue surface appears blue because it reflects blue wavelengths, while absorbing all others. All colors in objects result from selective absorption and reflection of light at various wavelengths.

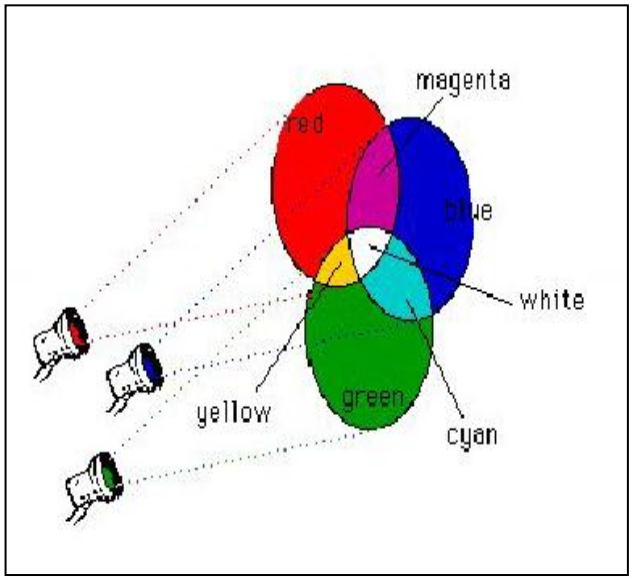

Fig 3.3 Perception Of Color By Absorbtion

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This figure graphically illustrates how the additive primaries RGB combine to produce other colors. In this example, the intensity, or amount, of each primary is equal. The colors produced by the equal combination of any two primaries, shown in the overlapping regions, are called secondary's. It is not a coincidence that the secondary's produced in additive color mixing are the same as the primaries used in subtractive color mixing. The opposite is also true. The equal combination of all three primaries is white, as shown in the center of the diagram.

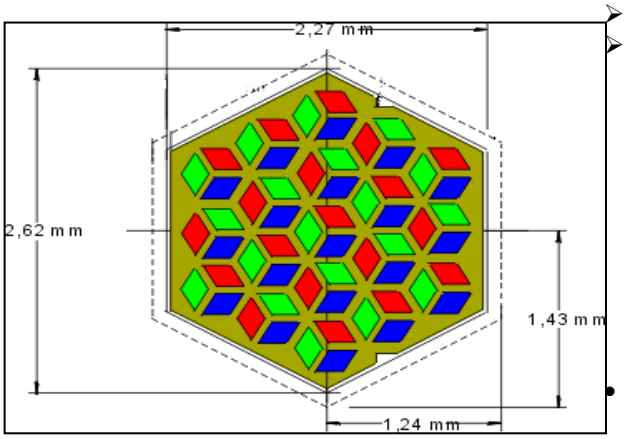

Fig 3.4 Color Sensor- MTCiS

III.4 FEATURES MTCSiCS-(True Color Sensor)

- 19 x 3 photo diodes integrated on chip.
- Allows signal frequencies up to MHz-range.
- Each of these photodiodes is sensitized with new dielectric spectral filter for its color range, preferably for the primary color standard CIE color space.
- High transmission.
- Slight ageing of the filter.
- High temperature stability.
- High signal frequency
- Reduced cross talk.
- Small size.

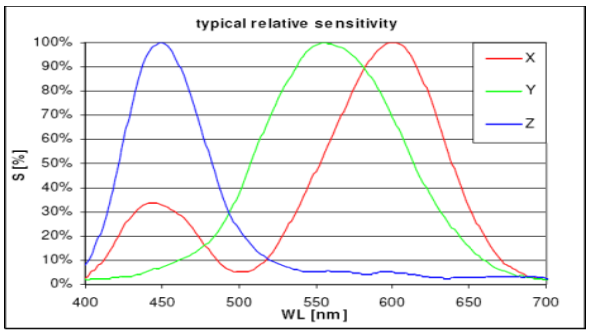

Fig3.5 Spectral characteristic

Figure: Typical (relative) sensitivity (XYZ) of the color sensor (MTCSiCS)
scanned by width broadband light and limited angle of incidence (<10°)4 5 6

III.5 SEED MOISTURE SENSOR

Seed Moisture –an important factor influencing quality and storability.
It is expressed on wet weight basis or dry weight basis

METHODS OF DETERMINATION

Moisture Meter
Air Oven For Moisture<8%

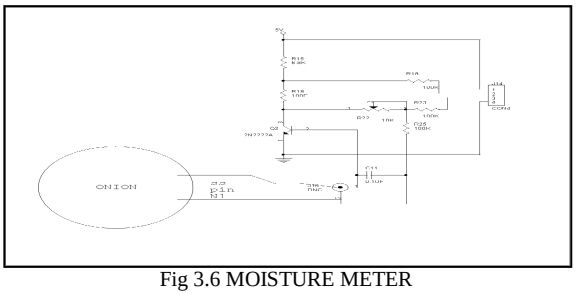

Fig 3.6 MOISTURE METER

- It consist of two rods held apart at some fixed distance by some insulating material.
- One of the probe is insulated to control the depth of the reading
- To change the depth you need to change the length of the insulated section.
- Exposed part of the probe takes the reading .
- Sensor is the resistive sensor.
- It has two probes to pass the current through the onionz.
- More water makes the onion to conduct electricity more easily (less resistance), While dry conducts electricity more poorly (more resistance).
- Resistance of material changes with temperature

II. OBJECT COUNTING SENSOR

- Designed to enable sensing in varity of application like limit switching and optical encoding.
- Gallium Arsinide Infra Red diodes and spectrally matched detectors are housed in modulated package to enable sensing.
- Gallium Arsinide Infra Red diodes with photo transistor is moduled in a rugged package.
- Responds to only emmited radiation from IR source.
- Only when reflective object is with in mechanical details ie with in mechanical details i.e with in field of view of the sensor .
- An infra-red transmitting filter eliminates ambient illumination problems

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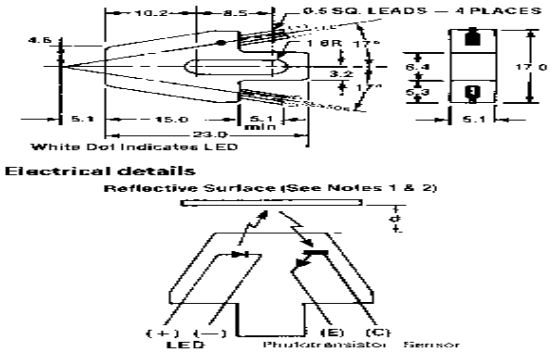


Fig 3.7 Object Counting Sensor.

SIGNAL CONDITIONING

Signal conditioning deals the amplification, attenuation, conversion of signal.

Parts of signal conditioning

a) Amplification.
b) Analog to digital conversion.

a) Amplification-Using MTI04BX-BF-A multichannel programmable trans impedance amplifier.
b) Analog to digital conversion.-ADC 08032-10 BIT

- The detection of colors is done by PIC MICROCONTROLLER 18F4550.
- The ADC-10 BIT is interfaced with the controller .
- The name of color which is detected is displayed using 20*4 LCD

DETECTION & DISPLAY

- The detection of colors is done by PIC Microcontroller.
- The ADC is interfaced with the controller.
- For display of various information like the weight, color and other database we are using 20*4 LCD

Separation

- After detection the color,and needed parameters microcontroller gives out signals to:
  a. Vibro coil
  b. Vibro Tray
- Vibrator coil vibrates the tray
- The tray consists of various slots for placing the onions of different colors, size and shape.

IV.WORKING

Working of the system:

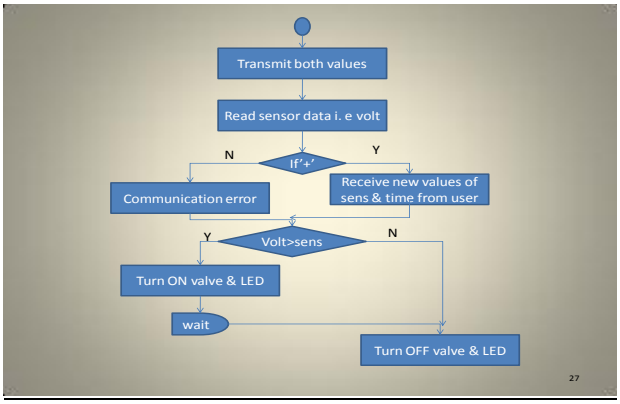
This is a microcontroller based project. By using this system onions can be separatedbased on different parameters within few minutes.

First of all, different colored onions are dropped into the hopper. The onions will fall onto the belt conveyor one by one as per the program given to the microcontroller. The vibro coil will vibrate the separator tray. This vibration is done using a vibro coil which is attached to the separator tray, The vibration of tray depends on the speed with which the coil vibrates. The appropriate vibration will cause the onions to be properly placed in the tray and once they are placed in a tray using sensors different parameters of the onion can be sensed.

The unwanted waste like the dust , rotted onions, covers of onions can also be separated by placing the blowers and with the help of infra sensors .

Once the detection of all the parameters is done ,these onions of different colors and size are send through different conveyors to the respective bins .After this they can be weighted with the weighing machine and then packed.

5. SOFTWARE DESCRIPTION



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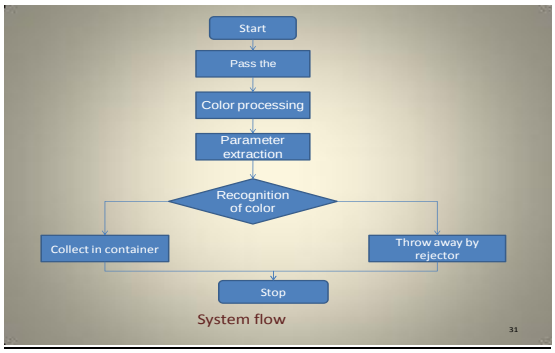

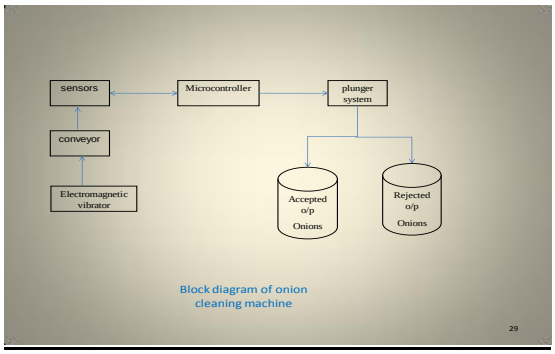

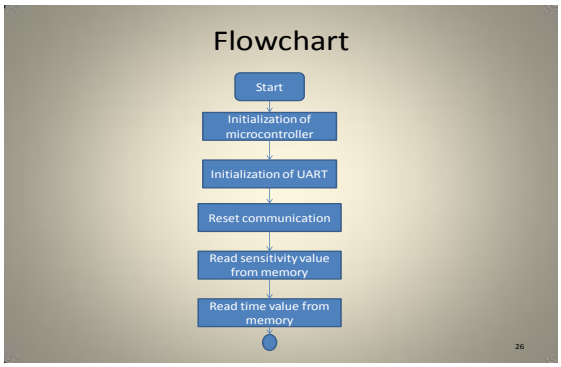

SOFTWARE DEVELOPMENT STAGES & PROCESS

The complete development of this system can be divided into the following stages:

- Problem definition stage;
- Designing block diagram;
- Implementing circuits and components;
- Developing algorithm for software;
- Writing actual code for Microcontroller;
- Compiling the code;

Burning the hex file into microcontroller with programmer;

Testing and Running.

VI. DESIGN METHODOLOGY

V1.1 Electromagnetic vibrator

Working

Onion mixture is allowed to flow from pan of electromagnetic vibrator so that mixture will flow smoothly. Vibratory feeder and shifter provided by various companies. They are basically of four types.

i. Linear feeder
ii. Volumetric feeder
iii. Bowl feeder
iv. Horizontal and circular shifter.

Figure 7.1 Electromagnetic vibrator

VIBRANT vibratory feeders & conveyors are flexible enough to handle vide variety of materials, weather hot or cold, fine or coarse, light or heavy. They are available as per customer's requirement in any material of construction, size of trough. The vibrations are generated using electromagnetic or unbalance Motor. The amplitude and frequency of vibration is selected at factory for different applications. Different standard models are also available with output capacities ranging from 200 Kg/h to 200 Tons/h. typical applications cover feeding, conveying, packaging, batching, drying.

VI.FEATURES

i. Can handle hot or abrasive material
ii. Can handle fragile materials (like potato chips) without degradation.
iii. Can be easily enclosed even at transfer end
iv. Special additional operations can be added like magnetic separation, heating, cooling, drying etc.
v. Offers completely adjustable control of rate of flow of material
vi. Available in various models from 200 kg/hr to 200 Tons/hr.

Specifications

i. Manufacturer: Vibrant
ii. Model VVF0
iii. Power: 0.1w
iv. Volts: 230volts

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VII. MERITS & APPLICATIONS

Merits

The system is automatic. Speed of the separation process is very high. Accuracy of the process is very high.

1. High Reliability.
2. A special image processing system is used for high speed of processing of spectral parameter.
3. High-Quality Ejector.
4. High rejection rate.
5. Ease of use.
6. System is cost effective.
7. High Flexibility.

Applications

1. This system can be used in food industry, rice mills.
2. It can also used at farms.
3. In the pharmaceutical industry to separate tablets of medicines.
4.In agricultural field for sorting of chilly, roses, food grains
5.Other uses are for separation of chalk ,soap ,textile, paper, toy.

VIII. RESULTS & CONCLUSION

CONCLUSION

- A faster, automatic , precise system for the cleanin of rice grains is designed.
- The system can replace the mechanical, conventional methods.
- Using RGB colors of light and photo sensor color of objects can be detected.

Thus our system can detect the color and separate it out successfully

Future scope

The prototype of the system is designed. The system can be further implemented on large scale . Further we can design same sorting machine for cleaning of rice, brown rice, sticky rice, Small yellow rice, sorghum, black rice. Further wheat, cereals, tea, beans, nuts, crops, seed, vegetable color sorter can be implemented.

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