RIPENING OF FRUIT USING COLOR SENSING

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I. INTRODUCTION

A strong and dynamic food processing sector plays a vital role in reduction in the wastage of perishable agricultural produce, enhancing shelf life of food products, ensuring value addition to agricultural produce, diversification & commercialization of agriculture, generation of employment, enhancing income of farmers and creating surplus for the export of agro & processed foods. In the era of economic liberalization, all segments including; private, public and co-operative sectors have defined roles to play and the Ministry promotes their active participation.

The Ministry of Food Processing Industries in India has a clear goal of attaining these objectives by facilitating and acting as a catalyst to attract quality investments from within India and abroad into this sector with the aim of making food processing a national initiative. With this overall objective, the Ministry aims to:

- Enhance farmer's income by better utilization and value addition of agricultural produce
- Minimize wastage at all stages in the food processing chain by the development of infrastructure for storage, transportation and processing of agro-food produce
- Introduce of modern technology into the food processing industries from both domestic and external sources
- Encourage R&D in food processing for product and process development and improved packaging.
- Provide policy support, andsupport for creation of Infrastructure, capacity expansion/ Upgradation and other supportive measures form the growth of this sectors.
- Promote export of processed food products.

This inspired the cause and strengthened the need for an experimental approach.Harvested fruits are normally consumed after 4 to 5 days of time period. Some fruits have to be consumed within very less time period where as some variety of fruits can be consumed after 10 days after harvesting. Damage present in the fruits may also vary based on fruits. Some kind of damage is visible to naked eye where as pest or insect damage may not be visible to naked eye. Manual picking of fruits and classifying them according to maturity and damage done may be time consuming and may not prepare for sending fruits to consumer within stipulated time. Taking these factors into consideration pre processing techniques can be applied to determine maturity and detecting damage done. Damage done by insects has visible blemishes on the skin of fruits. Sensor based method combined with image processing can be applied and to detect both maturity and damage at same time saving time Fruit maturity detection has many methods. Image processing and sensor based methods are most popular now. In image processing the high resolution images of fruits are taken and are preprocessed. Sensor based methods detect the gas emitted by fruits and based upon the parts per million of gas level detect the maturity of fruits.

There is a growing trend towards the consumption of fresh fruits and vegetables in the population worldwide, in part due to a growing interest in a more balanced diet, that includes a higher consumption of fiber, vitamins and minerals. Based on this, in part, by the lower caloric need of modern life, along with the awareness of the importance of taking care of healthy food for a better quality of life

As some fruits cannot ripen normally if detached from the parent plant when physiologically immature, and given the high rates of postharvest losses, coupled to the high cost in the actual production, harvesting, packaging and shipping fruit, to market, approaches to accurately and rapidly assess the level.

II. LITERATURE SURVEY

Anindita Septiarini, Hamdani Hamdani Heliza Rahmania Hatta , “Image-based processing for ripeness classification of oil palm fruit”(2019), International Symposium on Electronics and Smart Devices(ISESD).

Baohua Zhang, Jun Zhou, Xiaolong Yang , "Automatic Recognition of Ripening Tomatoes by Combining Multi-Feature Fusion with a Bi-Layer Classification Strategy for Harvesting Robots"(2018), IEEE International Conference on Industrial Technology (ICIT).

Arivazhagan Selvaraj, Lakshmanan Ganesan, Newlin Shebiah , "Fruit Recognition using Color and Texture Features"(2017), IEEE 6th Global Conference on Consumer Electronics(GCCE).

P Anupama, KV Sathees Kumar, S Rominus Valsalam, "An intelligent reflective color sensor system for agriculture systems"(2019), International Journal for Light and Electron Optics.

III. EXISTING SYSTEM

In Existing systems the ripe fruits are detected by using camera and image processing,this system is complex and costly.

3.1 IMAGE-BASED PROCESSING FOR RIPENESS CLASSIFICATION OF OIL PALM FRUIT

Anindita Septiarini; Hamdani Hamdani Published Image-based processing for ripeness classification of oil palm fruit in the 2019 5th International Conference on Science in Information Technology (ICSITech). Palm fruit is the result of agricultural products that are processed into vegetable oil. Nowadays, there are many daily necessities produced from palmfruit which cause demand for palm oil to increase sharply in the future. Therefore, image-based automation systems related to fruit ripeness classification continue to be developed to support the increasing result of production. In this paper, the classification method of palm fruit is aimed to distinguish three classes of fruit ripeness, namely raw, under-ripe, and ripe. The focus of this work starts from the segmentation process by applying the thresholding using the Otsu method. Following this, the color extraction features were employed by calculating two kind features, including the mean and standard deviation based on four-color components: red, green, blue, and gray, hence there are eight features produced. Lastly, classification is applied using the support vector machines method. This method was tested using 160 images with the successful rate indicated by an accuracy value of 92.5%.

3.2 AUTOMATIC RECOGNITION OF RIPENING TOMATOES BY COMBINING MULTI-FEATURE FUSION WITH A BI-LAYER CLASSIFICATION STRATEGY FOR HARVESTING ROBOTS

Jingui Wu, Baohua Zhang Published Automatic Recognition of Ripening Tomatoes byCombining Multi-Feature Fusion with a Bi-Layer Classification Strategy for Harvesting Robots in Research gate conference held on february 2019 Automatic recognition of ripening tomatoes is a main hurdle precluding the replacement of manual labour by robotic harvesting. In this paper, we present a novel automatic algorithm for recognition of ripening tomatoes using an improved method that combines multiple features, feature analysis and selection, a weighted relevance vector machine (RVM) classifier, and a bi-layer classification strategy. The algorithm operates using a two-layer strategy. The first-layer classification strategy aims to identify tomato-containing regions in images using the colour difference information. The second classification strategy is based on a classifier that is trained on multi-medium features. In the proposed algorithm, to simplify the calculation and to improve the recognition efficiency, the processed images are divided into 9×9 pixel blocks, and these blocks, rather than single pixels, are considered as the basic units in the classification task. Six colour-related features, namely the Red (R), Green (G), Blue (B), Hue (H), Saturation (S) and Intensity (I) components, respectively, color components, and five textural features (entropy, energy, correlation, inertial moment and local smoothing) were extracted from pixel blocks. Relevant features and their weights wereanalysedusingtheiterativeRELIEF(I-RELIEF) algorithm. The image blocks were classified into different categories using a weighted RVM classifier based on the selected relevant features. The final results of tomato recognition were determined by combining the block classification results and the bi-layer classification strategy. The algorithm demonstrated the detection accuracy of 94.90% on 120 images, this suggests that the proposed algorithm is effective and suitable for tomato detection.

3.3 AN INTELLIGENT REFLECTIVE COLOUR SENSOR SYSTEM FOR PAPER AND TEXTILE INDUSTRIES

P Anupama, K V Sathees Kumar Published An Intelligent Reflective Colour SensorSystem for Paper and Textile Industries in 2012 Sixth International Conference on Sensing Technology (ICST) The world is simply less colorful, without the sense of colour. In ordinary life, a difference in colour perception is mostly inconsequential. However, in many industries, the ability to sense colour precisely can be crucial. In this paper, a novel reflective colour sensing system is presented for process monitoring and control applications in paper and textile industries. The system is developed using a solid state RGB sensor and a smart signal processing algorithm implemented on micro controller architecture. A hybrid neural network comprising Self organizing mapping and Back propagation architecture is used for colour zone classification and exact color identification of papers. Demonstrator applications and simulation results are discussed to highlight the importance of sensor and accuracy in measurement.

3.4 DESIGN AND DEVELOPMENT OF COST EFFECTIVE ARDUINO BASED OBJECT SORTING SYSTEM

K.Murali Chandra Babu Published Design and Development of Cost Effective Arduino based Object Sorting System in 2020 International Conference on Smart Electronics and Communication(ICOSEC). For industrial applications, objects sorting is a tough task that requires continuous labour. It is advantageous to design a machine that spots the objects and rearrange them when a product matches predefined standards. This paper approach is proposed to sort the objects by using color identification with TCS3200 sensor. Identification of color is based on the frequency analysis from the output of the sensor. Chutes are used to place the product for color identification and for moving the container. Arduino nano controls the process of sorting with color identification. This system sorts colored objects and differentiates the objects to separate cases. Cost effective implementation of the system and size scalability makes the proposed system easier to implement in small scale industries minimizing the manual power.

IV. PROPOSED METHODOLOGY

The below Figure 4.1 specifies the block diagram of Ripen fruit classifier using color sensing. It consists of a Color sensor,servomotor, arm classifier and micro controller.

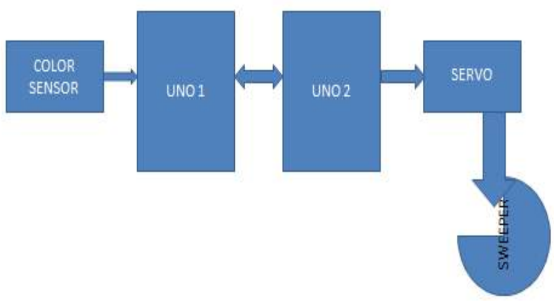


FIGURE 4.1 BLOCKDIAGRAM

PROPOSEDSYSTEM

Our Proposed design is based on Color Sensing, Color Normalization based on Sensors Accuracy and decision making for the Robotic Arm to classify them.

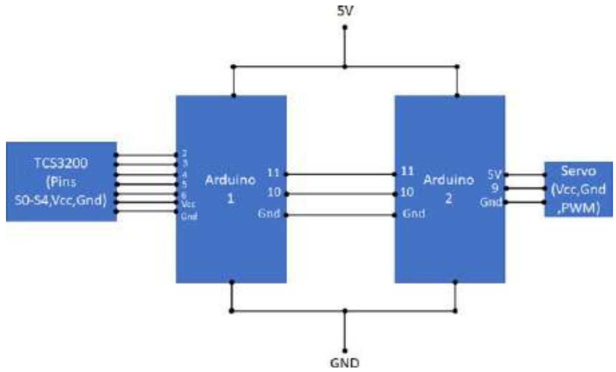


FIGURE 4.2 CIRCUIT DIAGRAM

Our Proposed design is described as below:

- A Inclined Path where the Food Raw Material (In Our Case: Lemons are taken. For Proof of Concept, We used Yellow and Green balls as an alternate for lemon).
- The Inclined path will lead to a Robotic Scanner position where the Color Sensor is placed. In our Case TCS3200 Sensor which senses based on Color Frequencies.

As in our case, the Test Element (Lemon), Yellow and Green are two colors. Since Yellow is a shade of Green mostly, there may be accuracy issues in identifying them.

1. Hence the Sensing is done for 100 Times in nearly five seconds and their mean value is taken for decision making.
2. Then based on the color the Lemon is pushed to left or right.
3. In our case, Incase of any unknown color other than these Two, the Operation is halted purposely to avoid any harmful objects to be accidentally passed for further processes.
4. In our case, We splitted the Work load between two Processing units
5. First one will sense the color and make the decision and pass it to the Other in Binary Code.
6. The Second Processor will process the Command and move the Servo Motor accordingly.

This method is a Low Power Consuming method for communicating between them comparing to other protocols because they,

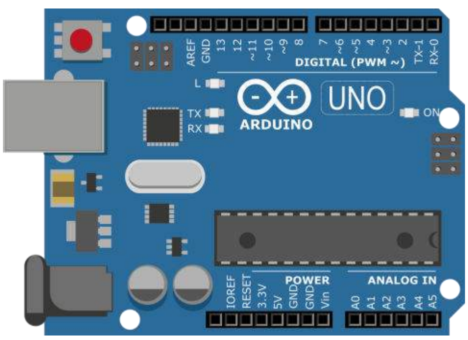
Code	Data Command
00	NoAction (Default)
01	Green
10	Yellow
11	Unknown

V HARDWARE DESCRIPTION

ARDUINOUNO

The Arduino Uno is an open-source micro controller board based on the Micro chip A Tmega328P micro controller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards(shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and Is programmable with the Arduino IDE (Integrated Development Environment) , via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-A like 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

FIGURE 5.1 ARDUINO UNO



The word "uno" means "one" in Italian and was chosen to mark the initial release of Arduino Software. The Uno board is the first in a series of USB-based Arduino boards; it and version 1.0 of the Arduino IDE were the reference versions of Arduino, which have now evolved to newer releases. The ATmega328 on the board comes pre-programmed with a boot loader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 upto version R2) programmed as a USB-to-serial converter. We choose the Arduino uno board because it is cheapest among all arduino boards on the basis of functionality.

TECHNICALSPECIFICATIONS

- Microcontroller:MicrochipATmega328P
- OperatingVoltage:5Volts
- InputVoltage:7to20Volts
- DigitalI/OPins:14(ofwhich6canprovidePWMoutput)
- UART:1
- I2C:1
- SPPI:1
- AnalogInputPins:6
- DCCurrent per I/OPin:20 mA
- DC Currentfor3.3VPin:50 mA
- FlashMemory:32KB ofwhich0.5KBusedbybootloader
- SRAM:2KB
- EEPROM:1KB
- Clock Speed:16 MHz
- Length:68.6mm
- Width:53.4 mm
- Weight:25g

GENERALPINFUNCTIONS

- LED: There is a built-in LED driven by digital pin 13. When the pin is high value, the LEDison, when the pin is low, it is off.
- VIN: The input voltage to the Arduino/Genuino board when it is using an external power source (as opposed to 5 volts from the USB

connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector(5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins by passes the regulator, and can damage the board.
- 3V3:A3.3volt supply generated by the on-board regulator.Maximum current draw is 50 mA.
- GND:Groundpins.

● IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work withthe5Vor 3.3V

● Reset: Typically used to add are set button to shields that block the one on the board.

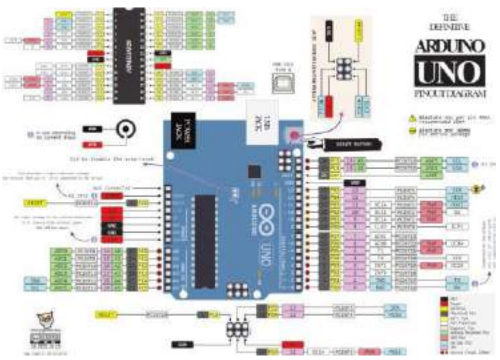


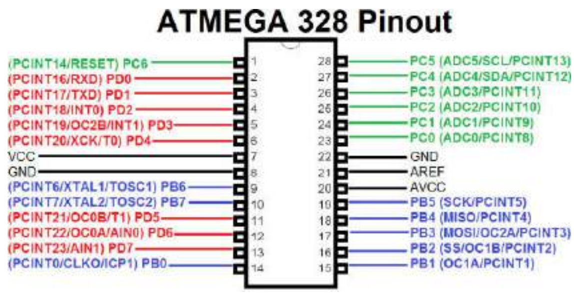
FIGURE 5.2 ARDUINOUNO PINOUT

SPECIALPINFUNCTIONS

Each of the 14 digital pins and 6 analog pins on the Uno can be used as an input or output, under software control (using pin Mode(), digital Write(), and digital Read() functions).They operate at 5 volts. Each pin can provide or receive 20 mA as the recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum of 40mA must not be exceeded on any I/O pin to avoid permanent damage to the micro controller. The Uno has 6 analog inputs, labeled A0 through A5; each provides 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of the range using the AREF pin and the analog Reference() function.

In addition ,some pins have specialized functions:

- Serial / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2USB-to-TTL serial chip.
- External interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value ,arising or falling edge, or a change in value.
- PWM (pulse-width modulation): pins 3, 5, 6, 9, 10, and 11. Can provide 8-bit PWM output with the analog Write() function.
- SPI (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK).These pins support SPI communication using the SPI library.
- TWI (two-wire interface) / I²C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.



AREF (analog reference): Reference voltage for the analog inputs.

FIGURE 5.3 ATMEGA328 PINOUT

COMMUNICATION

The Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART

TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows serial communication on any of the Uno's digital pins.

AUTOMATIC(SOFTWARE)RESET

Rather than requiring a physical press of there set button before an upload, theArduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to there set line of the ATmega328 via a 100nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip.

This setup has other implications. When the Uno is connected to a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB).For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e.anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened.

COLORSENSORTCS3200

TCS3200-DB Color Sensor Daughter board is a complete color detector, including a TAOSTCS3200RGB sensor chip, white LEDs, collimator lens, and stand offs to set the optimum sensing distance. The TCS3200 has an array of photo detectors, each with either are d, green, or blue filter, ornofilter (clear). The filters of each color are distributed evenly throughout the array to eliminate location bias among the colors. Internal to the device is an oscillator which produces a square-wave output whose frequency is proportional to the intensity of the chosen color. The applications of colour sensor are Test strip reading, Sorting by color, Ambient light sensing and calibration, Color matching

FIGURE5.4 COLORSENSORTCS3200

SPECIFICATIONS

- Supply Voltage:2.7V-5.5V
- Communicates Directly With a Microcontroller/Arduino
- High-Resolution Conversion of Light Intensity to Frequency
- Power Down Feature
- Programmable Color and Full-Scale Output Frequency

PINDESCRIPTIONS

- VDD-Supply voltage
- GND-Power supply ground

OUT-Output frequency (fo).

- S0,S1-Output frequency scaling selection inputs

S2,S3-Photodiodetype selection inputs.

WORKING

In the TCS3200, the light-to-frequency converter reads an 8 x 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters. When choosing color filter, the TCS3200 can allow only one particular color to get through and prevent other color. For example, when choosing thered filter, only red incident light can get through, blue and green will be prevented. Similarly, when choosing other filters we can get blue or green light.

The type of photodiode (blue, green, red, or clear) used by the device is controlled by two logicinputs,S2 and S3.

- For Ret photodiode both S2 and S3 are Low
- For Blue photodiode S2-Low and S3-High
- For Green both S2 and S3 are High
- When S2-High and S3-Low, none of

the filters is selected.

S0	S1	OUTPUT FREQUENCY SCALING (f0)
L	L	Power down
L	H	2%
H	L	20%
H	H	100%

TABLE 5.1 OUTPUT FREQUENCY SCALING

S2	S3	PHOTODIODETYPE
L	L	RED
L	H	BLUE
H	L	CLEAR(NOFILTER)
H	H	GREEN

TABLE5.2PHOTODIODETYPE

FIGURE5.5COLORPHOTODIODE

The sensor has four different types of filter covered diodes. In the 8x8 array of photodiodes, 16 photodiodes have Red filters, 16 have Blue filters, 16 have Green filters and the rest 16 photo diodes are clear with no filters. Each type can be activated using the S2, S3 selection inputs. Since each photodiode is coated with different filters each of them can detect the corresponding colours. For example, when choosing the red filter, only red incident light can get through, blue and green will be prevented. By measuring the frequency, we get the red light intensity. Similarly, when choosing other filters we can get blue or green light. We can also set the frequency scaling option by using the S0, S1 select lines. Normally, in Arduino 20% frequency scaling is used.

PROGRAMMING LOGIC

- First set the input pins as input and output pins as output. No need to use analog pins.
- Set S0 and S1 to high or low to set desired frequency scaling.

In loop, activate each filter by setting S2 and S3 to HIGH or LOW and measure frequency „fo" from 6th pin to get corresponding colour intensity. Compare frequencies of each colour to determine the colour of the object.

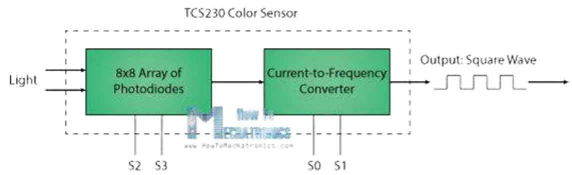


FIGURE5.6COLORSENSORINTERNALPROCESS

SERVOMOTORSG-90

There are lots of servo motors available in the market and each one has its own speciality and applications.

The following two paragraphs will help you identify the right type of servo motor for your project/system. Most of the hobby Servo motors

operate from 4.8V to 6.5V, the higher the voltage higher the torque we can

FIGURE5.7SERVOMOTORSG90

achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle.The gears in the motors are eaily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear.

FIGURE5.8 PARTS OF SERVOMOTOR

Next comes the most important parameter, which is the torque at which the motor operates. Again there are many choices here but the commonly available one is the 2.5kg/cm torque which comes with the Tower pro SG90 Motor. This 2.5kg/cm torque means that the motor can pull a weight of 2.5kg when it is suspended at a distance of 1cm. So if you suspend the load at 0.5cm then the motor can pull a load of 5kg similarly if you suspend the load at 2cm then it can pull only 1.25. Based on the load which you use in the project you can select the motor with proper torque. The below picture will illustrate the same.

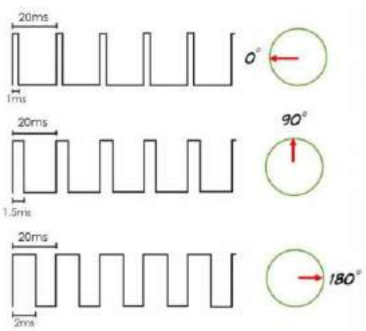


FIGURE5.9PWMOFSERVOROTATION

After selecting the right Servo motor for the project, comes the question how to use it. As we know there are three wires coming out of this motor. The description of the same is given on top of this page. To make this motor rotate, we have to power the motor with +5V using the Red and Brown wire and send PWM signals to the Orange colour wire. Hence we need something that could generate PWM signals to make this motor work, this something could be anything like a 555 Timer or other Microcontroller platforms like Arduino, PIC, ARM or even a micro processor like Raspberry Pie. Now, how to control the direction of the motor ? To understand that let us look at the picture given in the data sheet.

TOWERPROSG-90FEATURES

- Operating Voltage is+5V typically
- Torque:2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm
- Package includes gear horns and screws

Wire no.	Wire Color	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5 V is used
3	Orange	PWM signal is given in through this wire to drive the motor

APPLICATIONS

- Used as actuators in many robots like Biped Robot, Hexapod, robotic arm etc..
- Commonly used for steering system in RC toys
- Robots where position control is required without feedback Less weight hence used in multi DOF robots like humanoid robots.

CONVEYORBELT

A conveyor belt is the carrying medium of a dich conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with a closed loop of carrying medium the conveyor belt that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is

called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, over burden and more.

FIGURE5.10CONVEYORBEL T

CLASSIFIERARM

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm, the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. However, the term "robotic hand" as a synonym of the robotic arm is often proscribed.

FIGURE5.11CLASSIFIERAR M

USB CABLE

FIGURE5.12 USBCABLE

Arduino UNO and MEGA 2560 uses a USB (Universal serial bus) 2.0 Male to Male cable The USB cable has one end as USB type A connector and another end has a USB type B connector. The USB type-A end is connected to the power source or the programming device (e.g., your computer/laptop) and the USB B end is connected to an Arduino UNO or MEGA2560 board.

This cable has recently seen very less adaptation & upgrades, and as the world‟s technology is miniaturized this cable is seeing much less use than before. Although this cable‟s demand is kept alive by Arduino UNO & MEGA, and old days USB printers. Nowadays new designs of microcontrollers, boards and electronics devices prefer Micro USB instead. You can connect this cable to your DC power adapter, but before connecting to your Arduino board please check the power rating of the adapter. For a safe operation with Arduino, you should consider using it with your personal computer only.

Use it to connect Arduino Uno, Arduino Mega2560, or any board with the USB female A port of your computer.

USB A to B (Male to Male)

CODE & PROTOTYPE

APPENDIX

// TCS230 or TCS3200 pins wiring to Arduino #define S0 4

#define S1 5

#define S2 6

#define S3 7

#define sensor Out 8

// Stores frequency read by the photodiodes int red Frequency = 0;

int green Frequency = 0;

int blue Frequency = 0; void setup() {

// Setting the outputs pin Mode(S0, OUTPUT); pin Mode(S1, OUTPUT); pin Mode(S2, OUTPUT); pin Mode(S3, OUTPUT);

CONCLUSION

This project presents the idea of automating the food industry through RIPEN FRUIT CLASSIFIER USING COLOR SENSING project which classifies the ripened and un ripened fruits using color sensing and classifier arm which is used in major food industries. The mechanism works on a simple principle and there is not much complexity needed in the circuit and also works on low cost. This project outlines the basic idea of developing a system for classifying good and bad fruits and vegetables in large scale industries.

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Arivazhagan Selvaraj, Lakshmanan Ganesan, Newlin Shebiah "Fruit Recognition using Color and Texture Features(2017)", IEEE 6th Global Conference on Consumer Electronics(GCCE).

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