# Automatic real time weight based grading of fruits using Embedded System

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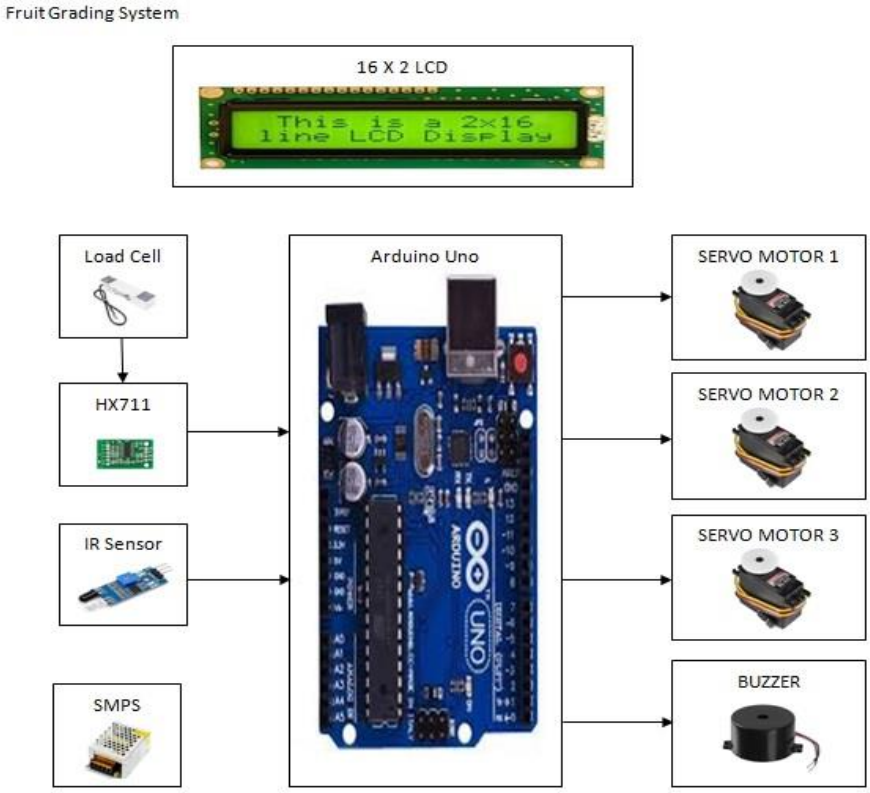
***Abstract :*** — Sorting of fruits is performed primarily by visual inspection using size as a particular quality attribute. Many industries with capability of large-scale buying and selling of fruits & vegetables, are using image processing technology for sorting purpose. But the image processing system of sorting requires very highly developed technology of image capturing and processing which is very costly and not suitable for small traders. The proposed sorting system in this paper offers an economical solution for such level of automated fruit sorting practices. By dealing with an automated material handling system, it aims in classifying the fruits by weight which is coming on the conveyor, by moving the fruits near its respective packing place. There by the monotonous work done by human is eliminated, achieving accuracy and speed in the work. Weight of fruit is used as a design metric to sort the fruits in food processing. And for sorting using weight as a parameter the load cell arrangement is ideal. This sorting system presents a precise, reliable, consistent and quantitative sorting technique for fruit sorting based on weight of the fruits. Automated sorting system not only speeds up the time of the process but also minimize error..

Keywords: Fruit, Load cell,

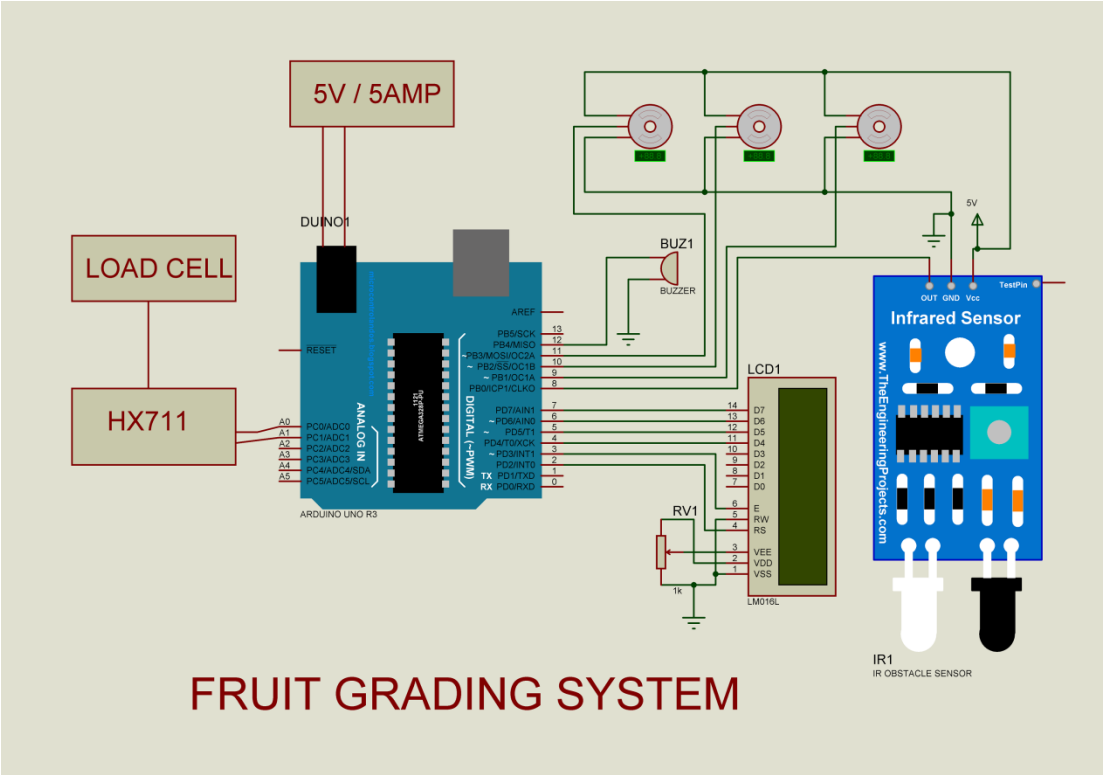
## I. INTRODUCTION

Fruit quality management system based on load cell provides a fully automated system designed to combine processes such as feature extraction and sorting according to weight. Weight of fruit is used as a design metric in food processing and for sorting using weight as a parameter the load cell arrangement is used. Embedded system has the advantage of high accuracy of sorting, high speed and low cost. This proposed system will have a good prospect of application in fruit quality detecting and sorting areas. This system performs the sorting and quality check using ARDUINO software.

## II. BLOCK DIAGRAM:



### III. CIRCUIT DIAGRAM:




### IV. BLOCK DIAGRAM DESCRIPTION

Fruit Grading system has following blocks:

1. Arduino Uno
2. Load cell with HX711 weighing sensor module.
3. IR Sensor
4. Servo Motor
5. Buzzer
6. SMPS

1. Arduino Uno:

Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality. The software used for Arduino devices is called IDE (Integrated Development Environment) which is free to use and required some basic skills to learn it. It can be programmed using C and C++ language.

2. Load cell with HX711 weighing sensor module:

Load cell is transducer which transforms force or pressure into electrical output. Magnitude of this electrical output is directly proportion to the force being applied. Load cells have strain gauge, which deforms when pressure is applied on it. And then strain gauge generates electrical signal on deformation as its effective resistance changes on deformation. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cell comes in various ranges like 5kg, 10kg, 100kg and more, here we have used Load cell, which can weight up-to 40kg.

Now the electrical signals generated by Load cell is in few milli-volts, so they need to be further amplify by some amplifier and hence HX711 Weighing Sensor comes into picture. HX711 Weighing Sensor Module has HX711 chip, which is a 24 high precision A/D converter (Analog to digital converter). HX711 has two analog input channels and we can get gain up to128 by programming these channels. So HX711 module amplifies the low electric output of Load cells and then this amplified & digitally converted signal is fed into the Arduino to derive the weight.

Load cell is connected with HX711 Load cell Amplifier using four wires. These four wires are Red, Black, White and Green/Blue. There may be slight variation in colors of wires from module to module. Below the connection details and diagram:

RED Wire is connected to E+
BLACK Wire is connected to E-
WHITE Wire is connected to A-
GREEN Wire is connected to A+

3. Ir Sensor:

IR Infrared Obstacle Avoidance Sensor Module has a pair of infrared transmitting and receiving tubes. When the transmitted light waves are reflected back, the reflected IR waves will be received by the receiver tube. The onboard comparator circuitry does the processing and the green indicator LED comes to life.

The module features a 3 wire interface with Vcc, GND and an OUTPUT pin on its tail. It works fine with 3v3 to 5V levels. Upon hindrance/reflectance, the output pin gives out a digital signal (a low-level signal). The onboard preset helps to fine tune the range of operation, effective distance range is 2cm to 80cm.

4. Servo Motor:

Servo motors have been around for a long time and are utilized in many applications. They are small in size but pack a big punch and are very energy-efficient. These features allow them to be used to operate remote-controlled or radio-controlled toy cars, robots and airplanes. Servo motors are also used in industrial applications, robotics, in-line manufacturing, pharmaceutics and food services. But how do the little guys work?

The servo circuitry is built right inside the motor unit and has a positionable shaft, which usually is fitted with a gear. The motor is controlled with an electric signal which determines the amount of movement of the shaft.

5. Buzzer:

Piezo buzzer is an electronic device commonly used to produce sound. Light weight, simple construction and low price make it usable in various applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezoceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound.

6. SMPS:

In our system we require 5 V 5 Amp SMPS. Servo Motor requires 2 amp current. At a time 2 servo motors will operate so we require minimum 4 amp SMPS.

## V. System Software

```
#include "HX711.h"
#include<LiquidCrystal.h>
LiquidCrystal lcd (2, 3, 4, 5, 6, 7);
#include <Servo.h>
Servo servo1;Servo servo2;Servo servo3; float weight;
int BUZZER = 12; int sw = 8; int sw_status; int i;
HX711 scale(A1, A0);    // parameter "gain" is ommited; the default value 128 is used by the library
void setup()
{
  servo1.attach(9);    // SERVO 1
  servo2.attach(10);    // SERVO 2
  servo3.attach(11);    // SERVO 3
  servo1.write(0);   servo2.write(0);   servo3.write(180);
  lcd.begin(2, 16);
  scale.set_scale(2280.f);
  scale.tare();
  pinMode(sw, INPUT);
  pinMode(BUZZER,OUTPUT);
}
```

```
void loop()
{
 measure_weight();
 sw_status = digitalRead(sw);
 while (sw_status == HIGH)
  sw_status = digitalRead(sw);
 digitalWrite(BUZZER, HIGH);
 delay(2000);
 digitalWrite(BUZZER, LOW);
 measure_weight();
 delay(1000);
 lcd.setCursor(0, 1);
 if (weight <= 100 )
 {
  lcd.print("Weight <= 100gm");
  servo3.write(120);
  push_fruit();
  servo3.write(180);
 }
 else if (weight <= 200 )
 {
  lcd.print("100gm <W <200gm");
  servo2.write(60);
  push_fruit();
  servo2.write(0);
 }
 else   if (weight <= 1000 )
 {
  lcd.print("200gm <W <1000gm");
  push_fruit();
 }
 delay(200);
}
void measure_weight()
{
 weight = ((scale.get_units(10) * 5.91 ) * (-1)) / 2;
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Weight = ");
 lcd.print(weight);
 lcd.print(" gm");
}
void push_fruit()
{
 servo1.write(60);
 servo1.write(0);
}
```

## VI. BRIEF OPERATION

In our system, we have to place the fruit on load cell mechanism. The IR sensor will detect the fruit and buzzer will turn ON. After that the weight of fruit is automatically measured and signals are give to servo motors. The first servo motor is used to push the fruit from load cell to separation mechanism. If the fruit weight is upto 100gm then second motor get the signal to sort this fruit. And if the fruit weight is in between 100gm to 200gm, then third motor get the signal to sort this fruit in another try. And if the fruit weight is above 200gm then no motor gets the signal. So the fruit will not be blocked. And that fruit will go straight.

## VII. CONCLUSION

The work in this project has resulted in a system having definite and systematic sequence of operations which are performed pleasingly in order to obtain the end result. It is testified that use of machine is an alternative for unreliable manual sorting. The overall system consists of mechanical and electronics segment.

## VIII. REFERENCES

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