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ONION GRADING SYSTEM

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Abstract: In India, the grading of onions is done manually or with a motorized grading equipment which prolongs the grading process and raises the labor costs. When an onion deviates from being perfect globular shape it has been discovered that grading mistake will increase therefore it is essential to the develop system for grading that is more precise and effective. The main objective of the project is to grade onions in three grades i.e., 20-40mm(small), 40-60mm(medium), ≥60mm(large) accurately and to make a portable system with reduced processing time. The proposed system presents an effective method that can help the classifying, has high accuracy and fast grading time that could meet industrial needs. The conveyer belt is build using Flexible Rubber of 2m length and 20cm width, Dc motor with 300Rpm and 12v geared, Roller of 6cm inner diameter. V pulley is used to support the motor movement, flat conveyor belt is considered having plywood as the supporting bed. Onions are passed through the conveyor belt where the sensor system is attached alongside of the belt to determine the diameter of the onions. The sensor system consists of ultrasonic sensor integrated using Arduino uno as controller. The data acquired from the sensor system is been processed using serial communication for sorting mechanism, in sorting mechanism onions are been graded into small, medium and large accordingly. Flapping system made up of servo motor and linear flaps is used to divert the onions to a particular direction based on the position of baskets. Onions are collected at three separate baskets kept at the end of the conveyor belt system. This project shall have an application in both farming and the upliftment of agricultural sector and the life of farmers.

Keywords—Conveyer Belt, Dc motor, Rollers, V pulleys, Sensor System, Sorting Mechanism and Linear flaps.

I. INTRODUCTION

Onion is one of the important vegetable crops. A global review of area and production of major vegetable crops shows that the onion ranks third in area and production. The grading of onion in India is performed manually or using motorized grading system which delays the grading process hence increases the labour charges. It has been found that there would be rise in grading error when onion deviates from perfect globular shape. Hence it is necessary to develop a system which more accurate and efficient for grading. The proposed system grades onion using sensors and conveyor system which makes the system more accurate with less human intervention. The system is also made cost effective and portable.

The proposed system presents an effective method that can help the classifying, has high accuracy and fast grading time that could meet industrial needs. The grading system comprises of three units namely conveyer belt system, sensor unit and sorting mechanism. Onions are passed through the conveyor belt where the sensor system is attached alongside of the belt to determine the diameter of the onions. The sensor system consists of ultrasonic sensor integrated using Arduino uno as controller. The data acquired from the sensor system is been processed using serial communication for sorting mechanism, in sorting mechanism onions are been graded into small, medium and large accordingly.

II. Methodology

2.1 Block Diagram:

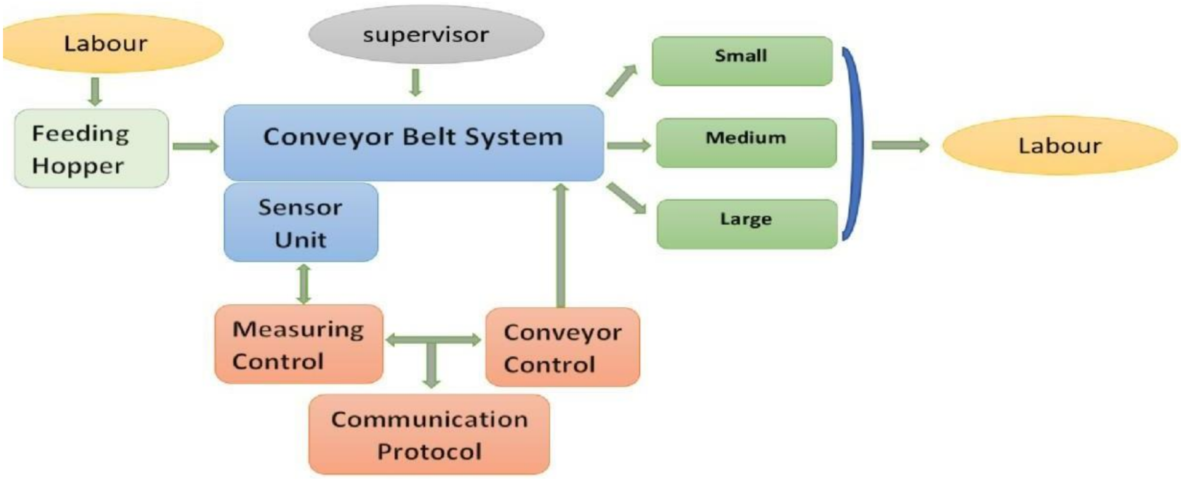

Figure 2.1: Block Diagram of Onion grading System

The system consists of following units:

1. Conveyor Belt System
2. Sensor System
3. Control Unit
4. Feeding Hopper
5. Communication Protocol

Initially the onions are fed into the conveyor belt which has sensors attached alongside to measure the diameter of the onions. Once the sensor system detects the diameter of onion, it is transferred to the controller used for the sorting mechanism using communication protocol. Two Arduino Uno devices are used as the controller for the sensor system and sorting part. The sorting mechanism diverts the onions to the respective racks based on the diameter which was measured using the sensor.

2.2 Conveyer Belt System

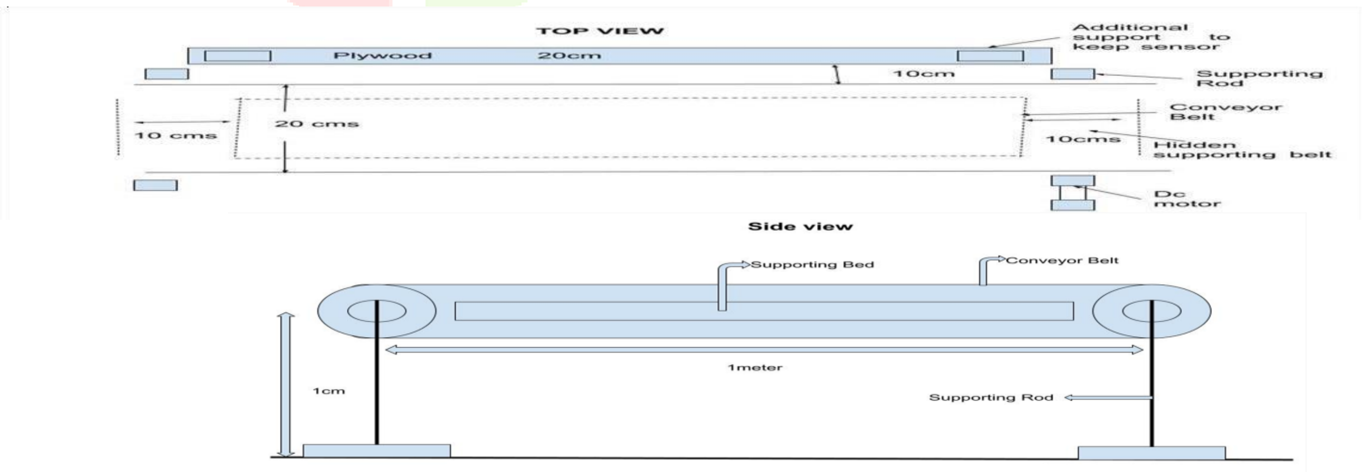

Figure 2.2: Top view and side view of the conveyor belt system

A conveyor belt is a looped belt that is driven by and wrapped around one or more pulleys. It is powered by an electric motor and supported by a metal plate bed or rollers upon which the conveyor belt rests. The pulley that powers a conveyor belt is referred to as the drive pulley and has an unpowered idler pulley. Pulley drives at the discharge end of a conveyor belt are referred to as head drives, while ones located at the infeed end are known as tail drives. The preferred type of pulley drive is a head drive located at the discharge end and uses pull force to move a conveyor belt. There is an endless number of types and uses for conveyors. All of the varieties serve the purpose of transporting materials and goods along a continuously moving path.

Though motorized conveyer belts are the tradition form of a conveying system, some systems use rollers without a motor to move materials. The efficiency of conveyor belt systems assists in improving productivity, saves on labour costs, and decreaseslead times.

Materials used to build the conveyor belt are as follows:

- Flexible Rubber (2m length,5mm thickness)
- Dc Motor with 100 Rpm and 12v (geared).
- Roller of 6 cm inner diameter
- Plywood (1m length, 20cm width)
- 8mm bearings - 4 pieces
- U-PVC (White color)-6cm diameter,20cm length(2pieces)
- 1/4 inch, 1 inch length-10 bolt & nut piece.
- Flex gum -1 bottle.

2.3. Sensor Unit

Sensors are placed along side of the conveyor belt. Sensors find the distance between the sensor and the object and thus the difference between the set of values are calculated and thus segregated. Initially Lidar sensor were used to find the distance, but due to inappropriate readings the system was been upgraded with ultra-sonic sensors.Two Ultrasonic sensors with alternate triggering frequencies were considered, but delay management was complicated thus a single ultra-sonic sensor is used to find thedistance.

DETECTION USING TWO ULTRA SONIC SENSOR

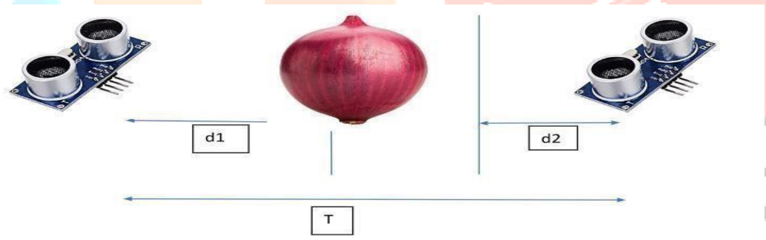

Figure 2.3: Detection using two Ultra Sonic Sensor

The sensors should be triggered at different time intervals and accordingly the distance between the onion and the sensor is been found as d1 and d2. As we know the total distance of sensor setup which is T, and thus T-(d1+d2) gives the diameter. But the proposed system is not efficient enough as it is a difficult to program the ultrasonic sensor at different time intervals. Thus this approach is not considered.

DETECTION USING ONE ULTRASONIC SENSOR

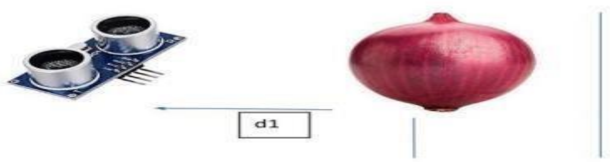

Figure 2.4: Detection using one ultrasonic sensor

The ultra sonic sensor is fixed at a particular place and thus the onion is moved, the maximum distance and minimum distance is measured. Thus, radius of the system is measured as follows r = max-min.

Thus, diameter is found by d=2*rTRIALS TO FIND THE DIAMETER

The ball is moved in three ways- slow, fast and very fast. The radius of the ball is calculated manually and the maximum and minimum distance between sensor and the object is calculated. Fig 2.5 shows the diameter detection setup using sponge ball and Fig 2.6 shows the Arduino ide code for the sensor setup to find the diameter .

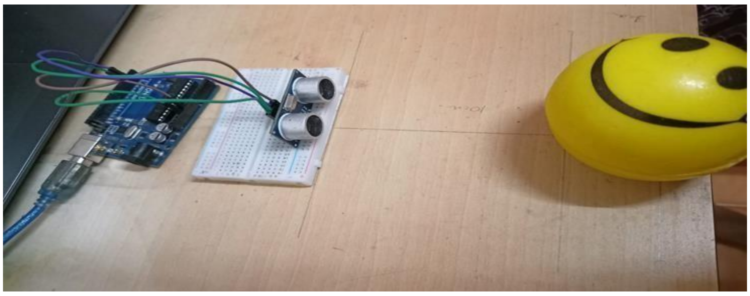

Figure 2.5: Diameter analysis using ultrasonic sensor

```
// defines pins numbers
const int trigPin = 3;
const int echoPin = 2;
// defines variables
long duration;
float distance;
void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  Serial.begin(9600); // Starts the serial communication
}
void loop() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);
  delay(10);
}
```

Figure 2.6: Arduino IDE programming for ultrasonic sensorTO FIND ACTUAL DISTANCE BETWEEN SENSOR AND THE OBJECT

The experiment is conducted in three ways-the ball is moved, ball is kept constant, the surface between the ball and the sensor is moved. Roll the ball in three ways- slow, fast, very fast with time delay 10ms and 100ms. Readings taken by moving sensors and also the object, it was seen that by moving the sensor there was large amount of disturbance when compared to object thus we cancelled the sensor movement, Readings were inaccurate due to airgap.

Moving the ball to find the appropriate delay

The ball was ben considered as the object and thus moved at different speed and thus segregated in the form of slow fast and very fast, and thus it was observed that at the delay of 100 the wave was having comparatively high amount of disturbance when compared to delay 10 thus it was been considered as the reference value. Fig 2.7 depicts the range of values obtained by considering delay of 10 and 100 .Fig 2.8 and 2.9 shows the smoothness in detection of the diameter over the surface

	A	B	C	D	E	F	G	H
1	DELAY(10)		delay(10)			delay(100)		
2	SLOW	slow	fast	very fast	slow	fast	very fast	
3	Distance:	11.31	10.46	10.32	11.1	10.64	10.88	
4	Distance:	9.49	9.1	9.27	10.57	9.27	8.04	
5	Distance:	9.33	8.62	8.79	9.4	7.55	6.95	
6	Distance:	9.69	8.25	9.32	7.97	7.85	9.27	
7	Distance:	9.32	8.18	8.89	8.08	7.6		
8	Distance:	8.84	8.01	9.69	8.01	8.48		
9	Distance:	9.15	7.96	9.74	7.91	8.14		
10	Distance:	9.55	7.58	11.22	7.97	8.25		
11	Distance:	8.36	8.01		7.67	9.27		
12	Distance:	8.77	7.43		7.65	10.66		
13	Distance:	9.1	7.43		7.96			
14	Distance:	8.67	7.04		8.08			
15	Distance:	8.77	7.06		8.08			
16	Distance:	9.2	6.94		9.28			
17	Distance:	9.1	6.53		9.83			
18	Distance:	9.5	7.53					
19	Distance:	7.87	7.53					
20	Distance:	7.89	6.53					
21	Distance:	7.77	6.53					
22	Distance:	8.62	7.04					
23	Distance:	9.13	7.06					
24	Distance:	7.82	6.94					
25	Distance:	8.13	6.94					
26	Distance:	8.55	6.53					

Figure 2.7: measured values of delay 10 and delay 100

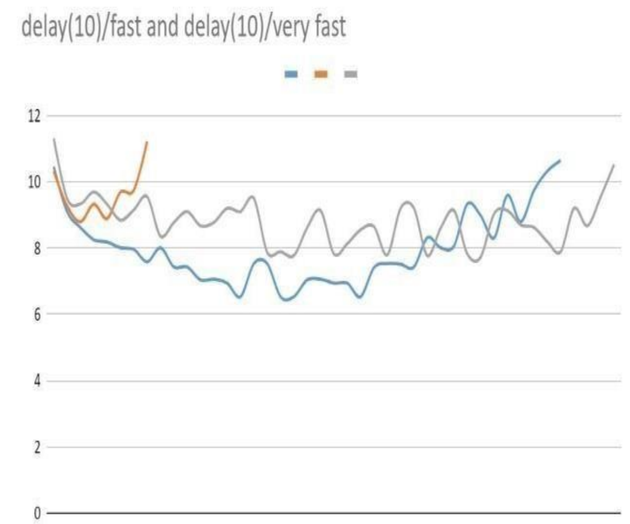

Figure 2.8: curve of delay10 **Figure 2.9: curve of delay 100**

Moving the ball and finding the time duration:

The ball is moved horizontally for 13cm and time taken to cover the distance is measured using stopwatch. Over a range of time, various values were been measured and thus accordingly the curve is been plotted. Amongst the range of values, the one value which give the least error percentage is been considered and thus is been considered as the reference value and thus the max min and the radius is been calculated. On considering delay of 10 Fig 2.10 depicts the range of trials taken with 10 ms and thus the amount of smoothness in the curve is been verified The distance v/s time measured is as shown below:

6.84	6.15	7.52	7.33	7.08	4.44	5.53	7.77	6.24	7.9	7.33	7.83	6.24
13.38	14.16	13.89	14.99	13.14	13.43	14.43	14.57	13.14	14.88	13.92	13.18	13.24
13.38	14.16	12.9	13.26	12.67	14.26	14.33	14.16	12.82	13.97	12.6	13.07	12
13.38	14.14	13.74	13.69	11.76	14.69	14.33	14.57	13.14	13.09	13.02	13.09	12.1
13.48	14.16	12.43	14.2	12.27	13.48	14.76	12.84	13.14	12.29	12.22	13.07	12
13.38	13.74	13.77	14.93	12.6	14.21	13.53	12.85	13.14	12.6	12.55	13.18	12
13.38	13.74	12.78	13.62	12.12	12.9	13.86	12.84	13.24	12.12	12.97	12.19	12
13.8	13.74	14.04	14.04	11.24	13.84	13.84	12.95	13.14	12.14	13.38	12.19	11.7
12.17	13.43	13.57	14.45	11.75	12.53	14.26	12.84	13.14	12.65	12.6	12.17	11.17
12.48	13.33	13.19	14.45	12.07	13.26	13.06	12.84	13.14	12.07	12.9	12.29	12.48
12.48	13.33	12.6	14.45	11.17	14.08	13.38	12.94	12.82	12.07	11.59	12.17	12.17
12.6	13.31	13.43	14.45	11.59	13.29	13.79	13.26	13.14	11.27	12.1	12.19	12.14
12.5	13.43	13.07	14.45	12.1	14.43	14.21	13.26	13.14	11.7	12.84	12.6	12.07
12.9	13.33	12.17	14.47	11.1	13.55	12.6	13.26	13.23	12	11.53	11.82	12.07
12.9	13.31	11.17	14.45	11.53	13.07	12.9	12.95	13.14	11.12	12.36	11.71	12.58
13.01	13.74	12	14.55	11.05	13.6	13.31	12.85	13.14	11.63	12.89	12.12	12
12.9	12.53	11.63	14.04	11.58	13.02	13.84	12.84	13.14	11.95	11.88	12.22	12.43
12.9	12.85	12.36	14.03	11.88	12.12	12.41	12.84	13.24	11.07	12.31	12.12	12.41
12.9	13.26	12.31	13.62	11.41	12.95	12.43	12.94	13.14	11.48	11.83	12.55	12.53
13.01	13.67	11.83	13.72	11.51	12.17	12.84	13.26	13.14	12	12.34	11.65	12.43
12.9	12.89	12.77	13.19	11.03	12.48	12.94	13.26	13.12	11.42	11.36	11.75	12
12.9	13.19	12.19	13.19	11.36	13.31	13.26	13.26	13.24	11.83	11.76	12.07	11.59

Figure 2.10: Range of values measuring the diameter

Fig 2.11 shows the manual calculation done by considering the range of value ,The maximum and minimum distance, error and error percentage and average speed with respect to speed is calculated ,in Fig 2.12 shows the reference value curve that is smoothness achieved while detecting the diameter of the object.

		P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	5.24	SPEED	8.27	6.84	6.15	7.52	7.33	7.08	4.44	5.53	7.77	6.24	7.9	7.33	7.83
2	3.24	RADIUS	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3	12	MAX	16.22	13.8	14.16	14.45	14.93	14.69	14.79	14.76	14.57	13.55	14.88	14.67	13.18
4	12.1	MIN	10.34	9.5	10.23	9.15	9.86	8.77	9.03	9.08	10.27	9.5	9.86	9.61	9.44
5	12	DIFFERENCE	5.88	4.3	3.93	5.3	5.07	5.92	5.76	5.68	4.3	4.05	5.02	5.06	3.74
6	12														
7	12	error	2.38	0.8	0.43	1.8	1.57	2.42	2.26	2.18	0.8	0.55	1.52	1.56	0.24
8	11.7	percentage error	68	22.85714286	12.28571429	51.42857143	44.85714286	69.14285714	64.57142857	62.28571429	22.85714286	15.71428571	43.42857143	44.57142857	6.857142857
9	1.17														
10	2.48	length concidered	13	13	13	13	13	13	13	13	13	13	13	13	13
11	2.17		8.27	6.84	6.15	7.52	7.33	7.08	4.44	5.53	7.77	6.24	7.49	7.33	7.83
12	2.14	average speed	0.6361538462	0.5261538462	0.4730769231	0.5784615385	0.5638461538	0.5446153846	0.3415384615	0.4253846154	0.5976923077	0.48	0.5761538462	0.5638461538	0.6023076923
13	2.07														

Figure 2.11: Calculations to find speed of the conveyor belt

Figure 2.12: Reference value curveIMPLEMENTING THE SENSOR MECHANISM ON THE CONVEYOR BELT

Sensor system is attached to the conveyor belt and thus the belt is moved at the speed of 300rpm and accordingly readings are taken. By the obtained reading it is observed that the error percentage is below 10 percent which is acceptable due to interference of the belt movement. And thus, can be concluded that faster the motor lesser the error rate. On assembling the sensor system on the belt there were range of reading taken with different measurements Fig

2.13 shows the 3 different objects readings and accordingly the calculations were made, manually Fig 2.14 shows the manual calculations done using data streamer .

A		B		C	
reading 1		reading 2		reading 3	
	8.91		7.91		7.72
	7.53		7.79		8.02
	7.89		6.77		7.6
	7.34		6.24		7.06
	6.68		4.96		7.41
	6.61		5.34		6.36
	6.19		5.27		5.75
	6.12		5.2		5.75
	6.05		4.73		5.92
	5.97		4.74		5.44
	5.92		4.73		5.73
	5.98		4.64		4.74
	5.51		4.62		5.29
	5.81		4.76		5.39
	5.68		5.27		5.66
	5.44		5.34		5.66
	5.44		4.96		5.81
	5.87		5.03		5.7
	5.73		5.98		5.29
	5.76		6.1		5.73
	5.75		6.22		5.46
	5.44		6.24		5.93
	6.21		8.57		6.29
	5.78		7.85		6.22

\+ ≡ Sheet1 ▾

Figure 2.13: Readings from sensor system

Thus, below mentioned will be the manual calculations of the readings obtained from the trails.

D	E	F	G	H
reference diameter	7.5	7.5	7.5	
minumum	5.44	4.62	4.74	
maximum	8.91	8.57	8.13	
deifference	3.47	3.95	3.39	
diameter	6.94	7.9	6.78	
error	0.56	-0.4	0.72	
percentage error	8.069164265	-5.063291139	10.61946903	

Figure 2.14: Manual calculation of diameter

Fig 2.15 depicts the smoothness of the curve ,how efficiently the onions diameter can be detected.

Figure 2.15: Resultant graph of speed 7.83ms

FINDING DIAMETER THROUGH THE SENSOR

On making the required changes in the code the readings are been considered and thus the maximum and the minimum is been detected. As the width of the belt is 20 cm , below which will be considered as the maximum value and the minimum will be 0. Thus the (max/min) formula is used to find the radius and thus accordingly 2*r is used to find the overall diameter. Fig 2.16 shows the diameter code been implemented in Arduino ide.

```
dist | Arduino 1.8.19
File Edit Sketch Tools Help
dist
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  //Serial.print("Distance: ");
  Serial.println(distance);
    /*
  if(distance<15)
  {
    minimum=min(minimum,distance);
    maximum=max(maximum,distance);
  }
  Serial.print(distance);

  Serial.print("Mini=");
  Serial.print(minimum);
  Serial.print("  Max=");
  Serial.print(maximum);
  Serial.print("  diameter=");
  Serial.println((maximum-minimum)*2);
 */
  delay(1);
}
```

Figure 2.16: Code to find diameter

25.98	25.38Mini=0.00 Max=14.79 diameter=29.58	25.74Mini=0.00 Max=14.89 diameter=29.78	77.06Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	25.38	25.74	77.06
25.98	24.85Mini=0.00 Max=14.79 diameter=29.58	25.74Mini=0.00 Max=14.89 diameter=29.78	78.08Mini=0.00 Max=14.89 diameter=29.78
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25.87	24.85Mini=0.00 Max=14.79 diameter=29.58	25.74Mini=0.00 Max=14.89 diameter=29.78	78.35Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	24.85	25.74	78.35
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26.38	25.81Mini=0.00 Max=14.79 diameter=29.58	24.55Mini=0.00 Max=14.89 diameter=29.78	79.80Mini=0.00 Max=14.89 diameter=29.78
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24.56	24.38Mini=0.00 Max=14.79 diameter=29.58	27.00Mini=0.00 Max=14.89 diameter=29.78	79.15Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	24.38	27	79.15
24.56	24.38Mini=0.00 Max=14.79 diameter=29.58	25.81Mini=0.00 Max=14.89 diameter=29.78	82.09Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	24.38	25.81	82.09
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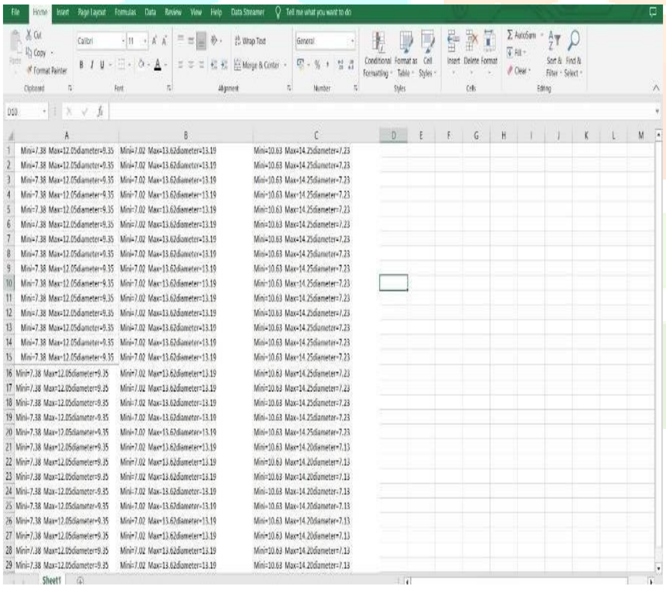
24.26	26.62Mini=0.00 Max=14.79 diameter=29.58	26.18Mini=0.00 Max=14.89 diameter=29.78	6.53Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	26.62	26.18	6.53
24.67	24.80Mini=0.00 Max=14.79 diameter=29.58	112.59Mini=0.00 Max=14.89 diameter=29.78	6.17Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	24.8	112.59	6.17
25.87	25.23Mini=0.00 Max=14.79 diameter=29.58	10.95Mini=0.00 Max=14.89 diameter=29.78	22.81Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	25.23	10.95	22.81
26.71	11.34Mini=0.00 Max=14.79 diameter=29.58	8.30Mini=0.00 Max=14.89 diameter=29.78	24.97Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	11.34	8.3	24.97
149.72	11.27Mini=0.00 Max=14.79 diameter=29.58	6.70Mini=0.00 Max=14.89 diameter=29.78	82.72Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	11.27	6.7	82.72
26.4	9.74Mini=0.00 Max=14.79 diameter=29.58	7.19Mini=0.00 Max=14.89 diameter=29.78	25.76Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	9.74	7.19	25.76
24.56	51.53Mini=0.00 Max=14.79 diameter=29.58	6.65Mini=0.00 Max=14.89 diameter=29.78	77.61Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	51.53	6.65	77.61
150.55	24.85Mini=0.00 Max=14.79 diameter=29.58	6.75Mini=0.00 Max=14.89 diameter=29.78	25.45Mini=0.00 Max=14.89 diameter=29.78
i=0.00 Max=10.44 diameter=20.88	24.85	6.75	
24.58	52.63Mini=0.00 Max=14.79 diameter=29.58	6.82Mini=0.00 Max=14.89 diameter=29.78	
i=0.00 Max=10.44 diameter=20.88	52.63	6.82	
361.05	25.38Mini=0.00 Max=14.79 diameter=29.58	7.31Mini=0.00 Max=14.89 diameter=29.78	
i=0.00 Max=10.44 diameter=20.88	25.38	7.31	
102.41	52.28Mini=0.00 Max=14.79 diameter=29.58	7.55Mini=0.00 Max=14.89 diameter=29.78	
i=0.00 Max=10.44 diameter=20.88	52.28	7.55	
8.43	52.28Mini=0.00 Max=14.79 diameter=29.58	7.60Mini=0.00 Max=14.89 diameter=29.78	
i=0.00 Max=10.44 diameter=20.88	52.28	7.6	

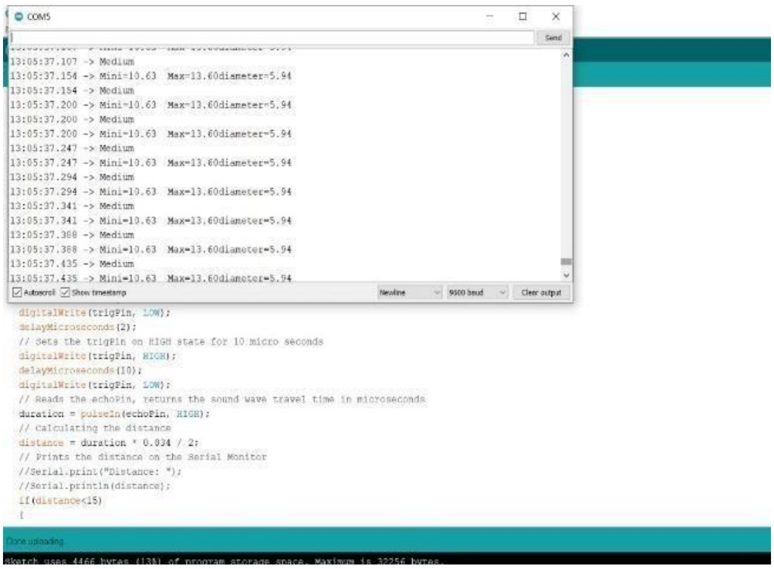
Figure 2.17: Diameter analysis

Range of values been detected by using the Arduino code and thus Fig 2.17 shows the manual detection of range of value

TRIALS DONE BY KEEPING ONIONS ON THE BELT

Onions were kept on the conveyor belt at this time 3 onions were considered and thus readings were taken ,it was been inferred that the onions of lesser diameter the ones which fall in the range of small ,are not appropriate due to small size the onions tend to roll causing deviation in the measurement.





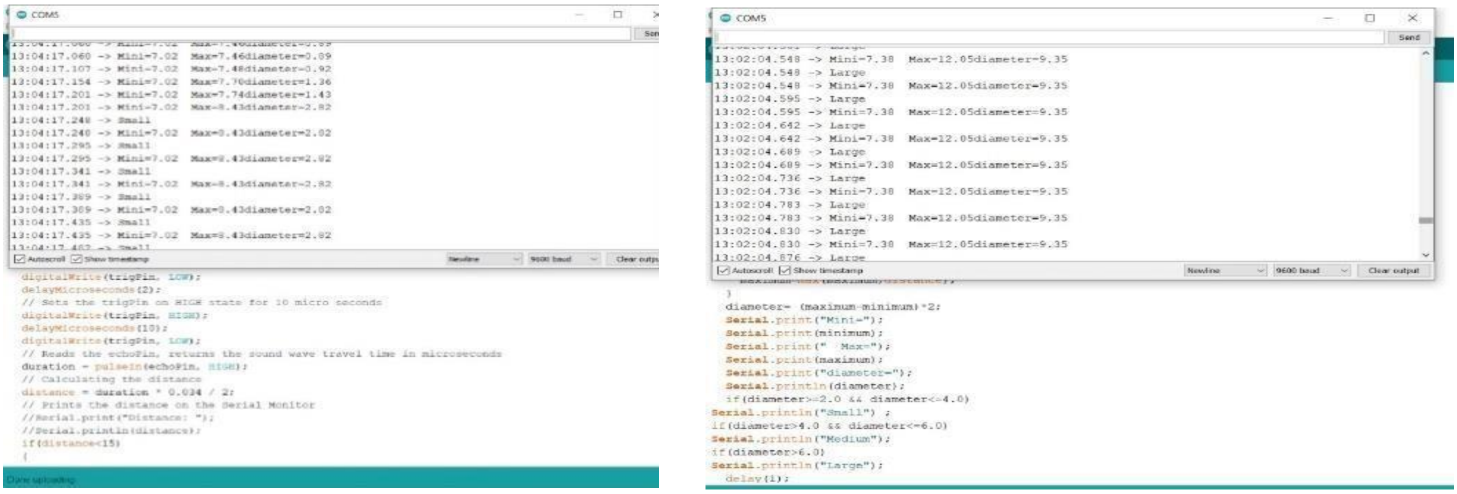


Figure 2.18: Trials done by keeping three onions

Fig 2.18 show the segregation between small medium and large onions.

2.4 Sorting Mechanism

The onion grading system's sorting component is divided into two components:

1.Detecting the presence of onion right before reaching the conveyor belt's sorting portion. 2.Directing the onion to the appropriate racks based on its diameter.

An IR sensor is used to detect the presence of onion. Once the onion is detected using the IR sensor , the next step is to divert the direction of the onion towards the baskets. The following design is used for the same.

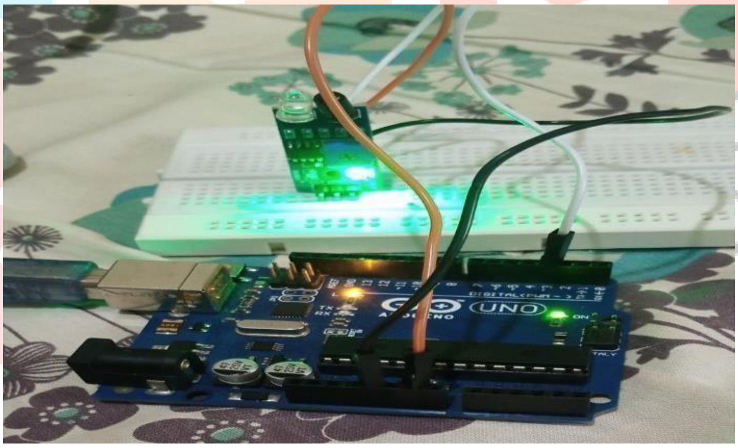


Figure 2.19: Detection using IR sensor

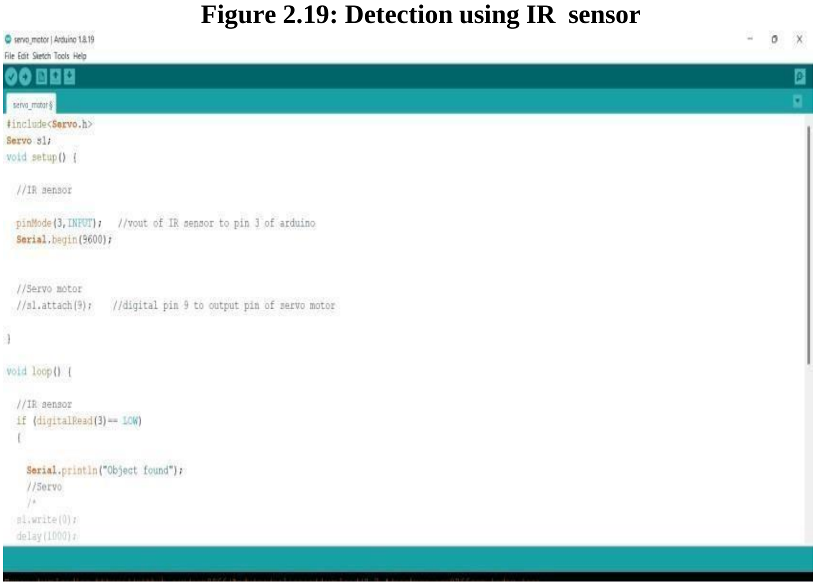


Figure 2.20: IR sensor code

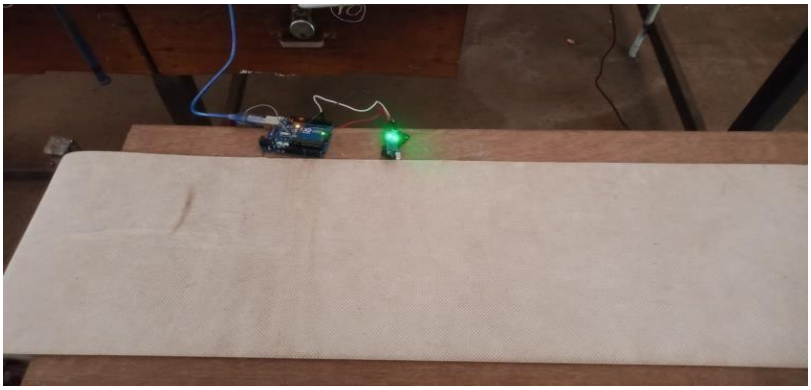


Figure 2.21:IR sensor interfaced with Arduino Uno implemented on a conveyer belt system

IR sensor module is interfaced to Arduino Uno. The sensor module is an active low mode sensor which means that whenever an object is present in front of the module, the data out pin goes to logic zero and so the programming is done accordingly. The sensing range is about 12 cm and is sufficient to detect the onions passing through the conveyor belt.

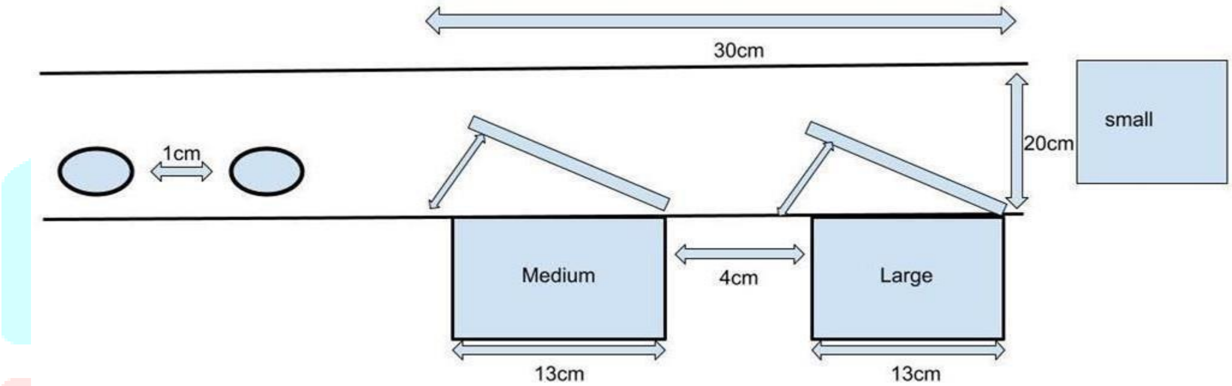


Figure 2.22: Flapping mechanism

Fig 2.22 is the idea setup for flapping mechanism An accurate and simple way to pass the onions to their respective racks according to the diameter is using the flaps. The flaps are moved whenever the onion reaches the rack. If two onions of the same size arrive, the flaps are kept open. The flap is moved using a servo motor with appropriate torque.

Moving Flaps:

The plywood flaps are utilized for the sorting process. The dimensions of the flaps utilized are as follows: Length:15 cm, Width: 2.2 cm, Thickness: 1.2 cm or 0.6 cm.

Figure 2.23: Flaps

SERVO MOTOR

Figure 2.24 :Servo motor

Servo motors are comprised of a DC motor, gears, a potentiometer to determine its position and a small electronic control board. The torque of this servo motor is 1 kg/cm.

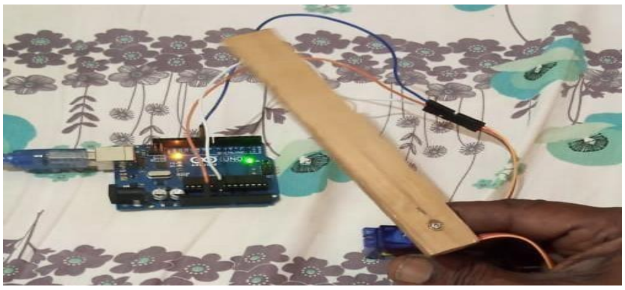


Figure 2.25: Servo Motor based flaps interfaced with Arduino

A servo motor-based flap was designed which uses Arduino uno as the controller. Although the torque of servo motor is 1 kg/cm and is theoretically appropriate for moving the onions, practically it is not sufficient. Thus, a servo motor with higher torque has tobe used.

III. Results and Discussion

A conveyor belt system was developed with a speed of 300 rpm. This speed ensured the grading of 1 to 3 tons of onions per hour. The system was made portable. The diameter of the onion was determined using an ultrasonic sensor. The diameter obtained by the ultrasonic sensor is found to be accurate which improves the overall system accuracy.

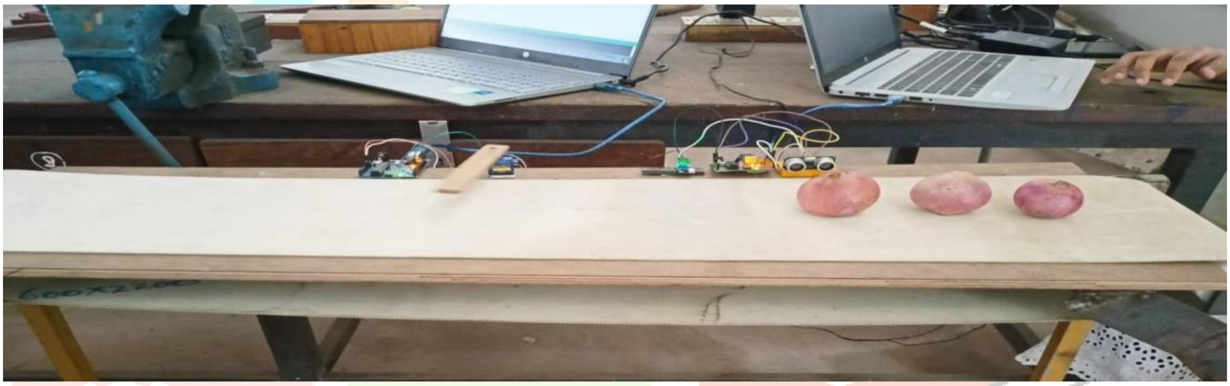


Figure 3.1: Onion Grading System

Trials were taken by keeping three onions in the conveyor belt to measure the diameter. Among the three onions, first one is large onion, second one is medium sized onion and the last one is a small onion. The readings were taken and it was observed that it was difficult to detect the onions with smaller diameter compared to the onions with larger diameter. This is due to the faster movement of conveyor belt which causes movement of small onion which makes it difficult to sense. Whereas movement of larger onion is lesser compared to smaller one which gives accurate diameter measurement. The percentage of error for the detection of diameter of the onion less than 10%. Fig 3.2 shows the detection of onions kept on the conveyor belt consecutively and the acquired smoothness curve.

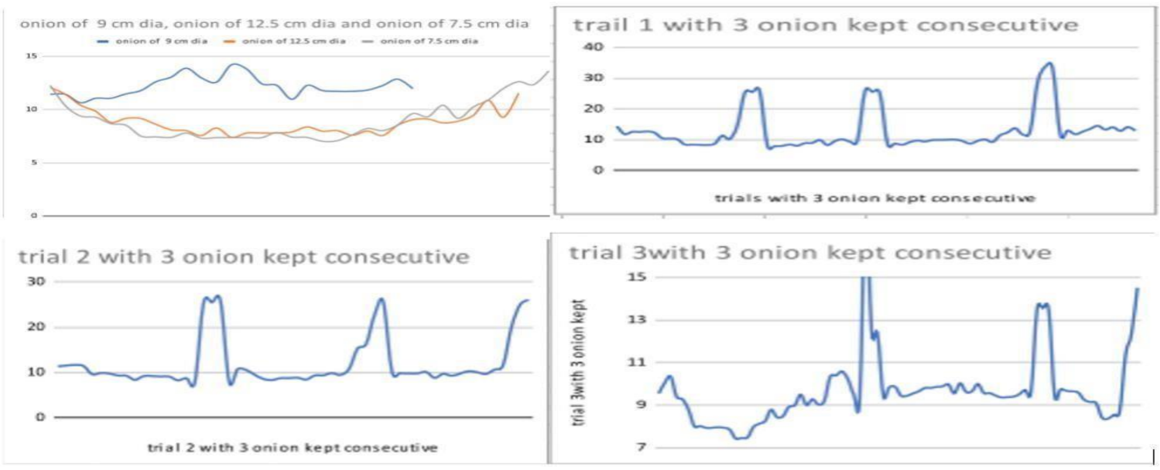


Figure 3.2: Graphs obtained for trials of diameter measurement using Ultrasonic Sensor

IV. Conclusion and Future Scope

The proposed system grades the onions based on its size as small (20-40mm), medium (40-60mm) and large(≥large). A conveyor belt system with a speed of 300 rpm assures the grading of 1 to 3 tons of onions per hour. Onions are passed through the conveyor belt where the sensor system is attached alongside of the belt to determine the diameter of the onions. The sensor system consists of ultrasonic sensor integrated using Arduino uno as controller. The data acquired from the sensor system is been processed using serial communication for sorting mechanism, in sorting mechanism onions are been graded into small, medium and large accordingly. Accurate diameter measurement has been performed which increased the system accuracy.

The system can be further implemented on large scale. The designed system is not limited to the onions, it could be used to separate food items like citrus fruits, apples, grapes etc. of different diameter. Onions' freshness and quality can be assessed using image processing in conjunction with grading them according to size. This project shall have an application in both farming and upliftment of agricultural sector and life of farmers.

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REFERENCES

[1]S. N. A. K. R. R. S. S. P. G. S.Angalaeswari, "Automatic Vegetable Differentiator," IEEE International Conference on Power, Control, Signals and Instrumentation Engineering, 2017.

[2]J. H. J. Jongmin Park, "Development of a Low-cost and High-efficiency Post-harvest Bulk Handling Machinery System of Onion – Performance Evaluation and Control.," Korean Journal of packaging science &Technology., 2020.

[3]P. N. P. A. Aniket V. Joshi, "Review Paper on Physical and Mechanical Properties of Citrus Fruits and Various Techniques used in Fruit Grading.," IJSTE - International Journal of Science Technology and Engineering, 2016.

[4]C. L. Weilin Wang, "Size estimation of sweet onions using consumer-grade RGB-depth sensor.," Journal of Food Engineering, 2014.

[5]J. W. A. M. M. M. A. M. S. F. a. S. N. Mohd. Muzamil, "A Low Cost Divergent Type Apple Grader for Kashmiri Apples.," International Journal of Current Microbiology and Applied Sciences., 2018.