University of Mumbai

WEIGHT DETECTION USING LOAD CELL AND HX711 MODULE (SECURITY)

Submitted at the end of semester VI in partial fulfillment of requirements

For the degree of

Bachelors of Technology

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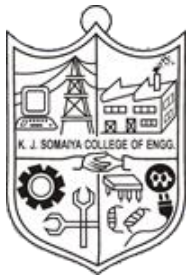

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Batch 2017 -2021

K. J. Somaiya College of Engineering, Mumbai-77

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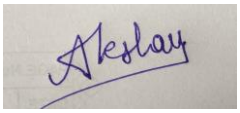
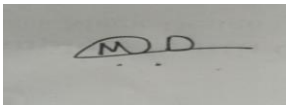
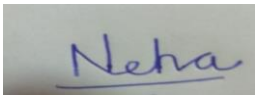
 **Signature of the Student** **1713016** **Roll No.**	 **Signature of the Student** **1713017** **Roll No.**
 **Signature of the Student** **1713055** **Roll No.**	

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Abstract

The security of any items is very much which is placed in art galleries, exhibitions, malls, jewelry shops, showrooms were precious items are kept to showcase the beauty and price of products and even as a window shopping. People take a look on such precious, antique, valuable products. But there are chances of robbery in such places where such products are placed. To overcome this situation and make all products secured from robbers this project is designed. The system of this project helps the owner to have watch on the products. This system works on sensing a small to large change in weight. Owner place the product on this and calibrate the system according to the weight of the product. This weight now becomes the idealized weight. When someone touches the weight there is change in weight of the product this change alarms the owner that someone touches the weight and trying to steal it. The alarm is the LED which also can be replaced by the high power BUZZER. This system is so accurate that it can sense 0.01gram change in weight instantly. The alarm turns ON in friction of seconds. By the use of this system one can secure the products placed in art galleries, exhibitions, malls, jewelry shops, showrooms easily. The system is low cost system and can be calibrated for different weights. The system is small and feasible to handle and others cannot see the system kept below any product.

List of Figures

Nomenclature

1. Vcc = 5 Volts
2. Ground = 0 Volts
3. E+ = Excitation +
4. E- = Excitation -
5. A+ = Amplifier +
6. A- = Amplifier -
7. DT = Digital Output
8. SCK = Serial Clock

Contents

Chapter 1

Introduction

This chapter presents a brief idea of the project and motivation behind this project and also presents scope of the project. This provides a brief description of project.

1.1 Background

Our project topic is **WEIGHT DETECTION USING LOAD CELL AND HX711 MODULE (SECURITY).** In this project, we have made a system where anything of any weight which needs to be secured can be secured using this. If a precious item is kept on the load cell and anyone tries to touch or pick that item the LED turns ON which indicates the owner of item that someone is trying to stole the item. Such a way the owner is aware about the security of the item. The owner can calibrate this system for any weight and keep that item to secure. The pre-requisites for this project are basic understanding of load cell, HX711 module and basic coding for calibration and to make function of LED as an alarm.

1.2 MOTIVATION:

There are so many cases of robbery in art galleries, exhibitions, malls, jewelry shops, showrooms were precious items are kept to showcase the beauty and price of products and even as a window shopping. So to secure all such items from theft this project and the system can prevent the precious items from theft. This is so accurate that this can sense 0.01gram of change in the actual weight of item. This can notify the owner instantly that someone touches the item. Because of this system the item is kept secured in exhibitions, malls, jewelry shops.

Such systems can be feasible to install at a low cost and high security with a high level of accuracy in sensing the changes. Also with the change in the calibration of the system the different weights item can be secured timely.

1.3 SCOPE OF THE PROJECT:

The product is flexible to be upgraded and updated at every course of time. This can be made more and more feasible to the owner of the system. We can add IoT features that it can notify the owner without being nearby to the secured items. It can also have different alarming techniques such as call the owner, direct message and notification to the security in charges, and even informing the local police. Even we can have a camera which can shoot the footage when alarming situation occurs. It can also have the features to count the number of visitors in front of the items. This system can also be stored at home and owner can have proper watch on their items remotely. Bank lockers can also install this system and monitor the item kept in locker.

1.4 BRIEF DISCRIPTION OF PROJECT UNDERTAKEN:

Our project needs a perfect setup to start accurately. So for this, the load was placed strongly on a wooden board so the strain of any weights maintains fully on a load cell and which helps the load cell to measure the weight of item kept on it and also the small changes of 0.01gram can also be sensed by the load cell. Load cell is a component which works on a basic wheatstone bridge network which converts measurable weights to a small electrical signal. Now, this is low voltage output so we need to amplify the signal to a high voltage output which can be easily read by arduino.

After these two setups of load cell and HX711 module, we need to set the calibration factor for 0.00kg weight. For a known weight of 100gm, we got calibration factor as -650000. When 100g of weight was kept on the load cell, the observed reading was 0.10kg. When 200g of weight was kept on the load cell, the observed reading was 0.20kg. So it was also observed that we can measure weight with 100% accuracy (the some measured weight is shown above as measured weight). We considered the weight of secured product as 200g and were kept on load cell.

Now, LED was connected for security of the product as shown in the breadboard connection. When 200g of weight was kept on the load cell, the output was OFF LED. As someone touches and tries to remove the secured product, the weight changes on load cell. Now the weight on the load cell is more or less than 0.20kg. It was observed that the LED gets ON when someone touches and tries to remove the load.

Chapter 2

Literature Survey

1. For understanding load cell completely we need to search for its basics working principal first. Then we got to know the importance of assembling it properly on a wooden board to maintain perfect strain. Got to understand the design and functions of load cell. Load cell basically converts physical measurable weights to a low voltage output signal. Also the wiring configuration.
2. Now to convert low voltage output signal generated from load cell to high voltage output signal. So for this purpose we need HX711 module which amplify the voltage signal and also work as an Analog to Digital Converter (ADC). Then we got to understand the pin configuration of this module and this provided us the importance of every pin.
3. Now perfect interfacing or connection of load cell with hx711 module was done with proper precautions that any of the connections won't touches each other. Because the contact of any connection, with other connection leads to false calculation of load. Such false calculation leads to making product less secure. Even because of connection contacts module can get damage.
4. We need to install arduino ide software on laptop so that the coding and interfacing is done. For this we also need to download basic library which used in arduino code frequently. Even we understood how to upload our code to arduino board and how to see the output on ide software.
5. To understand arduino properly we need to understand its pin configuration so that we can connect the pins with proper vcc and ground. Also understood the input/output (I/O) pins in and arduino board.
6. To connect hx711 module to arduino board so that the arduino gets proper input which is generated with the help of load cell. Thus, connection of all 4 output pins of module (vcc, ground, DT, SCK) with arduino board was done.
7. Now after the connection of hx711 to arduino we need to download the hx711 interfacing library on arduino ide software so that arduino can read output from hx711 module and the interfacing can be proper.
8. After the library is installed the commands are run on arduino ide software to get proper weight. For this we need to calibrate our load cell using a calibration factor and to get the calibration factor we need to do trial and error method with a known load.

9. As arduino reads the weights perfectly then we need to take a weight which need to be secured. Now as we got a secured weight we need to modify our previous code more accurately and add some looping commands so that anyone touches the secured weight the LED turn ON indicating that someone touching the secured weight and want to pick it.
10. To connect LED properly with arduino and get proper output one should know how to connect LED without supplying it high voltage.

Chapter 3

Project Design

This chapter explains briefly the components and software used to create the project.

3.1 PROBLEM STATEMENT:

Nowadays, security of any item is very much necessary which is kept such a way that people can have a look to it closely but can't touch or pick it. So to overcome the issues faced by many owners of art galleries, exhibitions, malls, jewelry shops, showrooms were precious items are kept to showcase the beauty and price of products this project is made. This system works when anyone touches or tries to pick the product than the LED turn ON which indicates the owner that someone is trying to steal the item. This system is highly accurate to sense the touch.

3.2 OBJECTIVES:

Our objective is to detect the weight of the product which need to be secure and then trigger the LED/BUZZER that alarm the owner, that there is change in actual weight of product, which means someone is trying to stole that product.
We can also measure the weight of product and calibrate this product for different weights of product.

3.3 COMPONENTS REQUIRED:

Hardware Components used:

Arduino uno

HX711 module

Load cell 3kg

Resistor

LED

Connecting wires

Jumper wires

Software used:

Arduino IDE

3.4 DESCRIPTION OF COMPONENTS

3.4.1 Load Cell:

A load cell (or loadcell) is a transducer which converts force into a measurable electrical output. Although there are many varieties of force sensors, strain gauge load cells are the most commonly used type.

A load cell works by converting mechanical force into digital values that the user can read and record. The inner working of a load cell differs based on the load cell that you choose. There are hydraulic load cells, pneumatic load cells, and strain gauge load cells. Strain gauge load sensors are the most commonly used among the three. Strain gauge load cells contain strain gauges within them that send up voltage irregularities when under load. The degree of voltage change is covered to digital reading as weight.

Load cell circuit is also known as a Wheatstone Bridge Circuit.

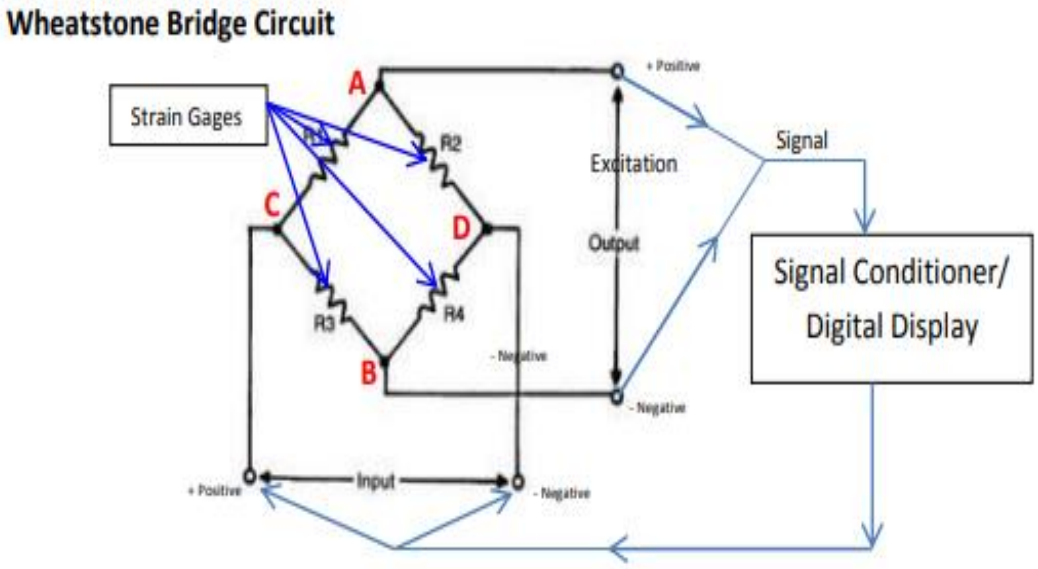

Fig3.1

3.4.2 HX711 Module:

The output signal produced by the load cell is in range of millivolts, so we need an amplifier to convert the signal into a level that we can later transform it into a digital signal and process it. For this purpose, we use HX711 amplifier sensor. The HX711 amplifier sensor includes a HX711 chip with analog-to-digital conversion capability in 24-bit accuracy. The HX711 module amplifies the low-voltage output of the load cell and sends it to the Arduino so that the Arduino eventually calculate weight from this data.

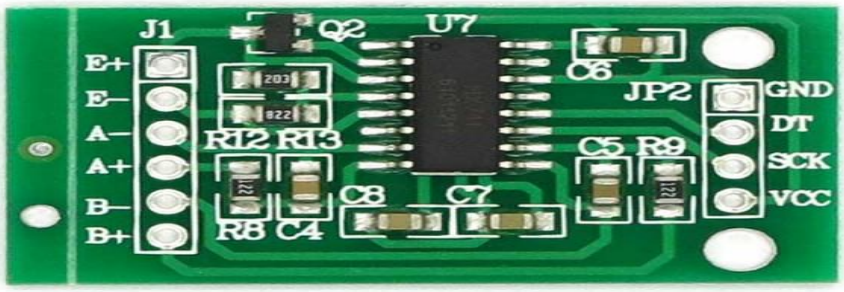

Fig3.2

3.4.3 ARDUINO UNO BOARD:

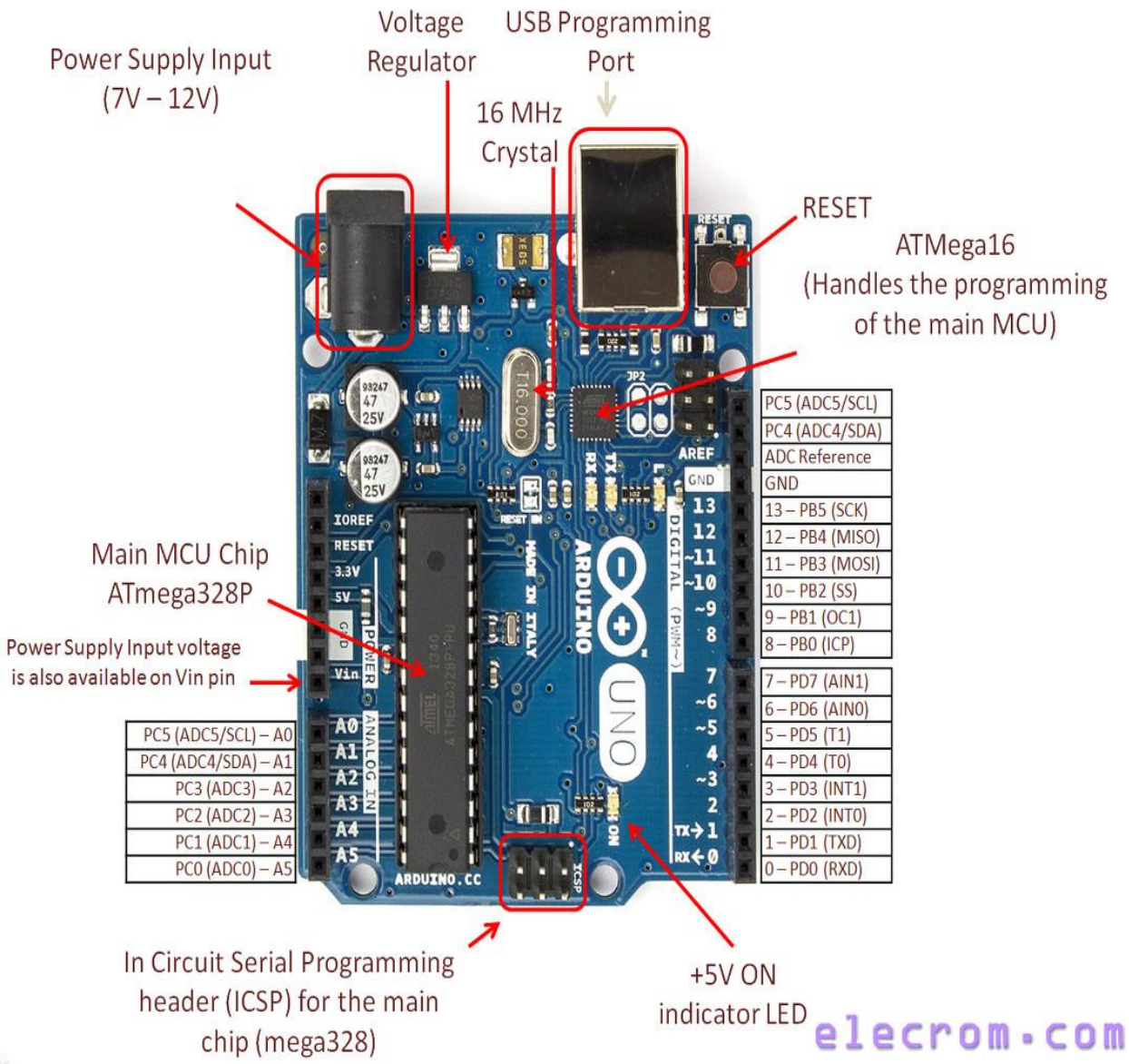

Fig3.3

3.4.4 Arduino IDE:

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands.

3.5 BLOCK DIAGRAM:

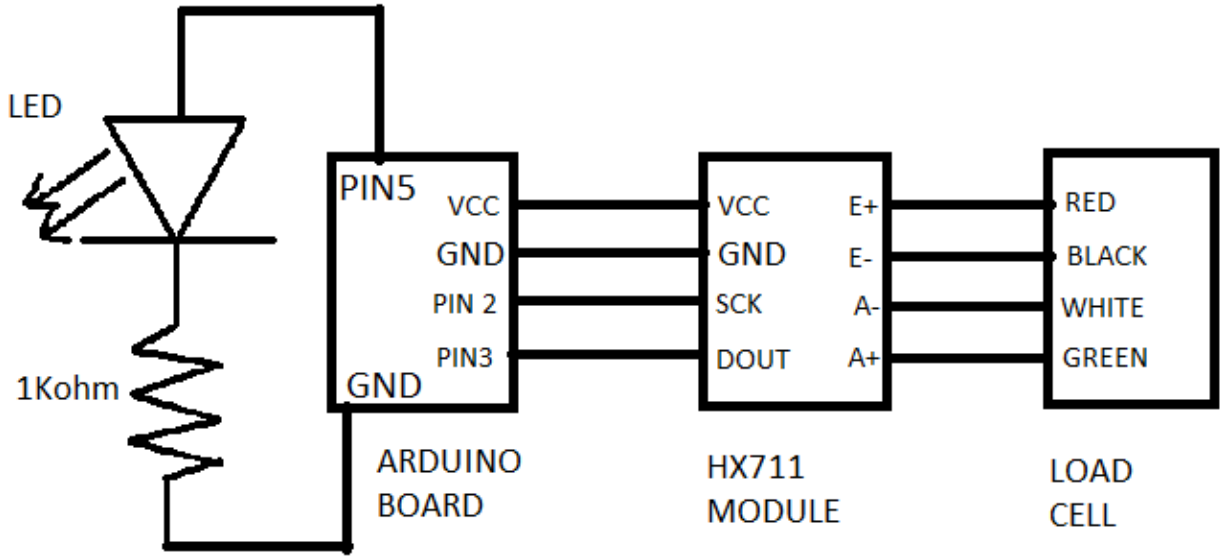

Fig3.4

3.6 Accuracy of Measured weight:

50grams

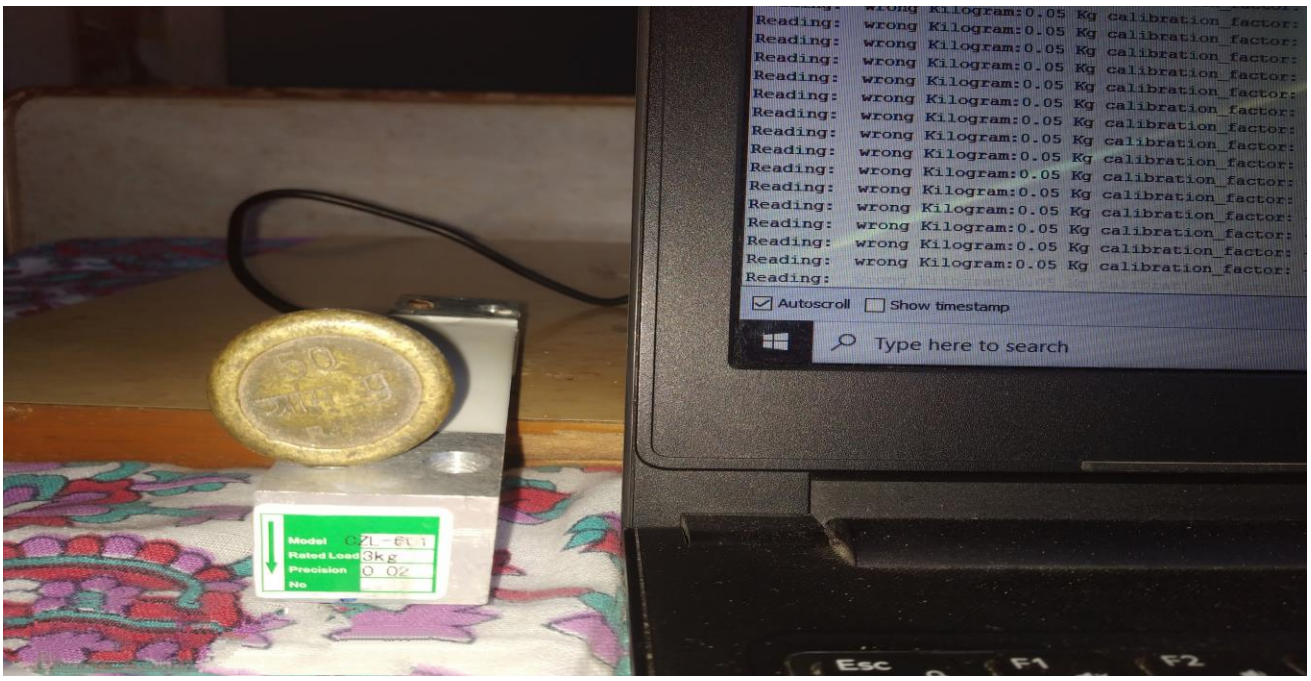

Fig3.5

100grams

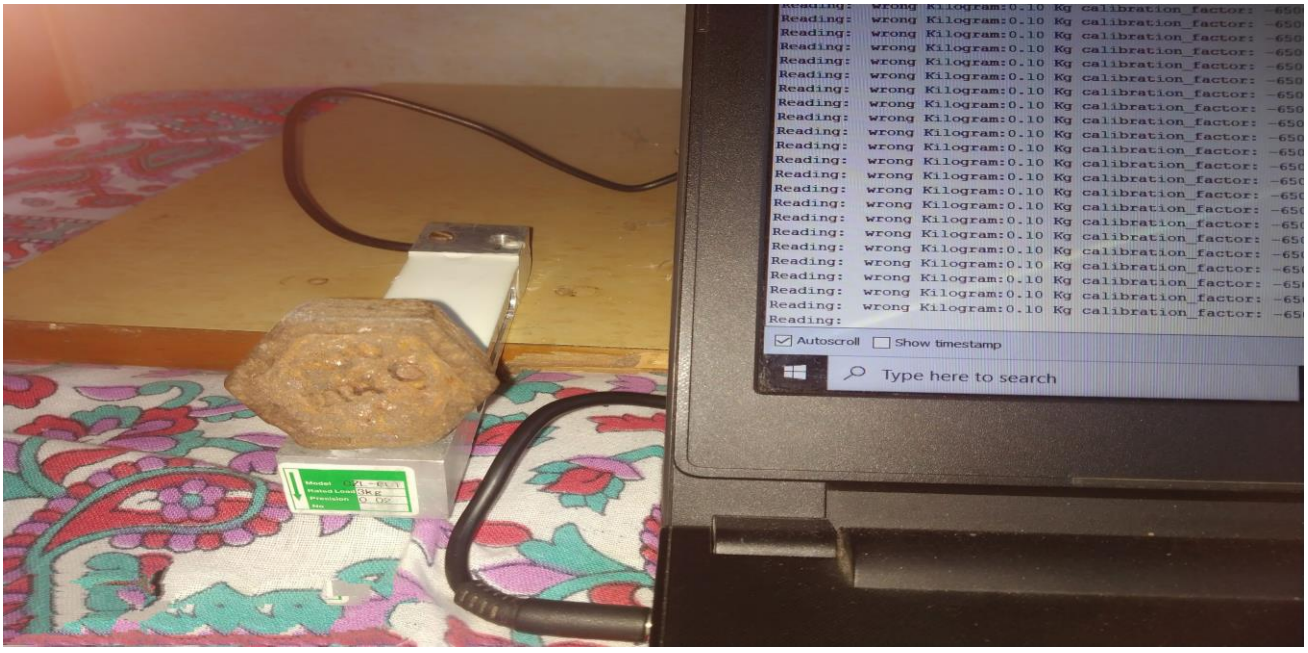

Fig3.6

200grams

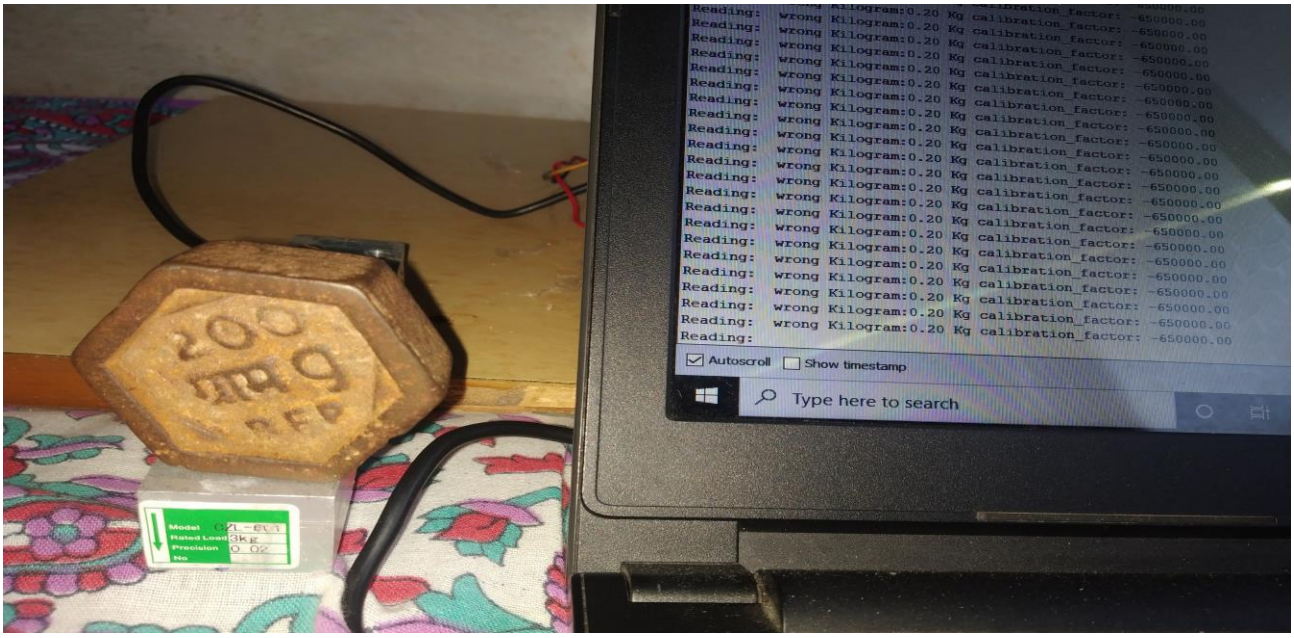

Fig3.7

400grams

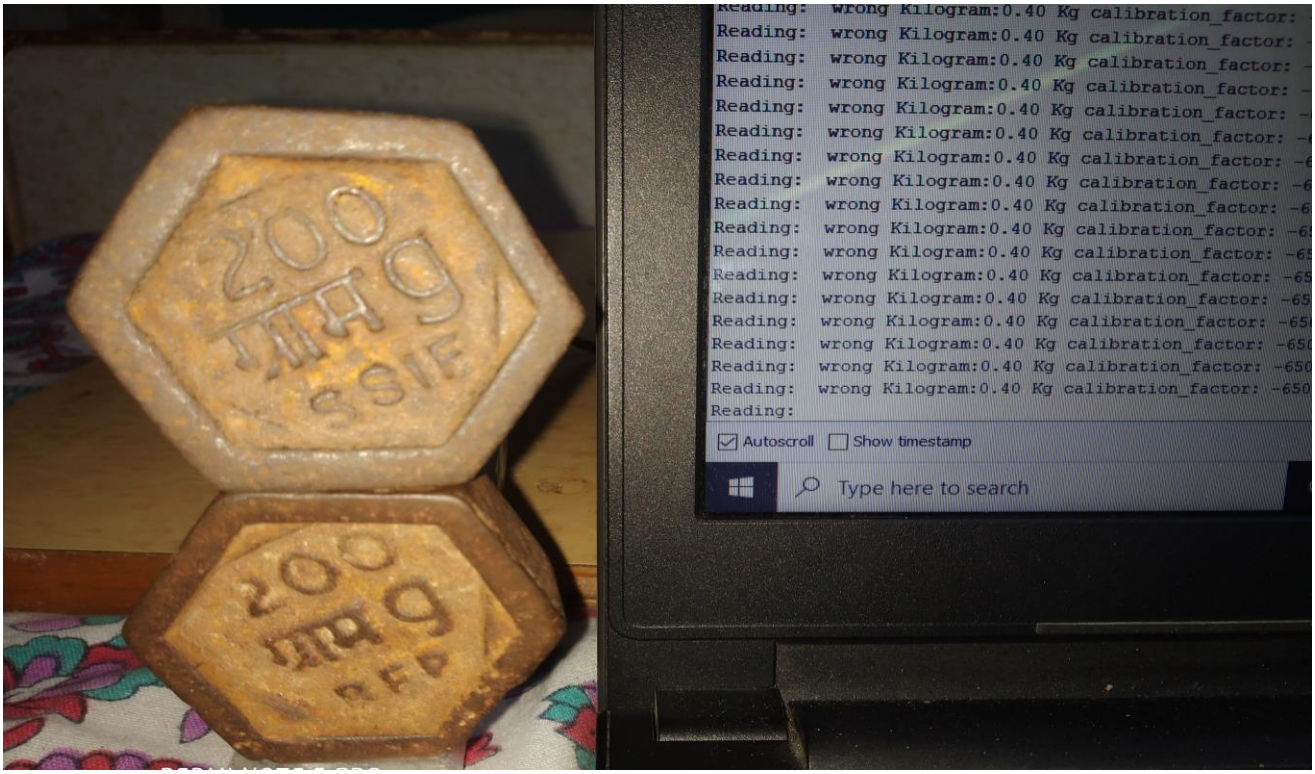

Fig3.8

3.7 PHYSICAL CONNECTIONS:

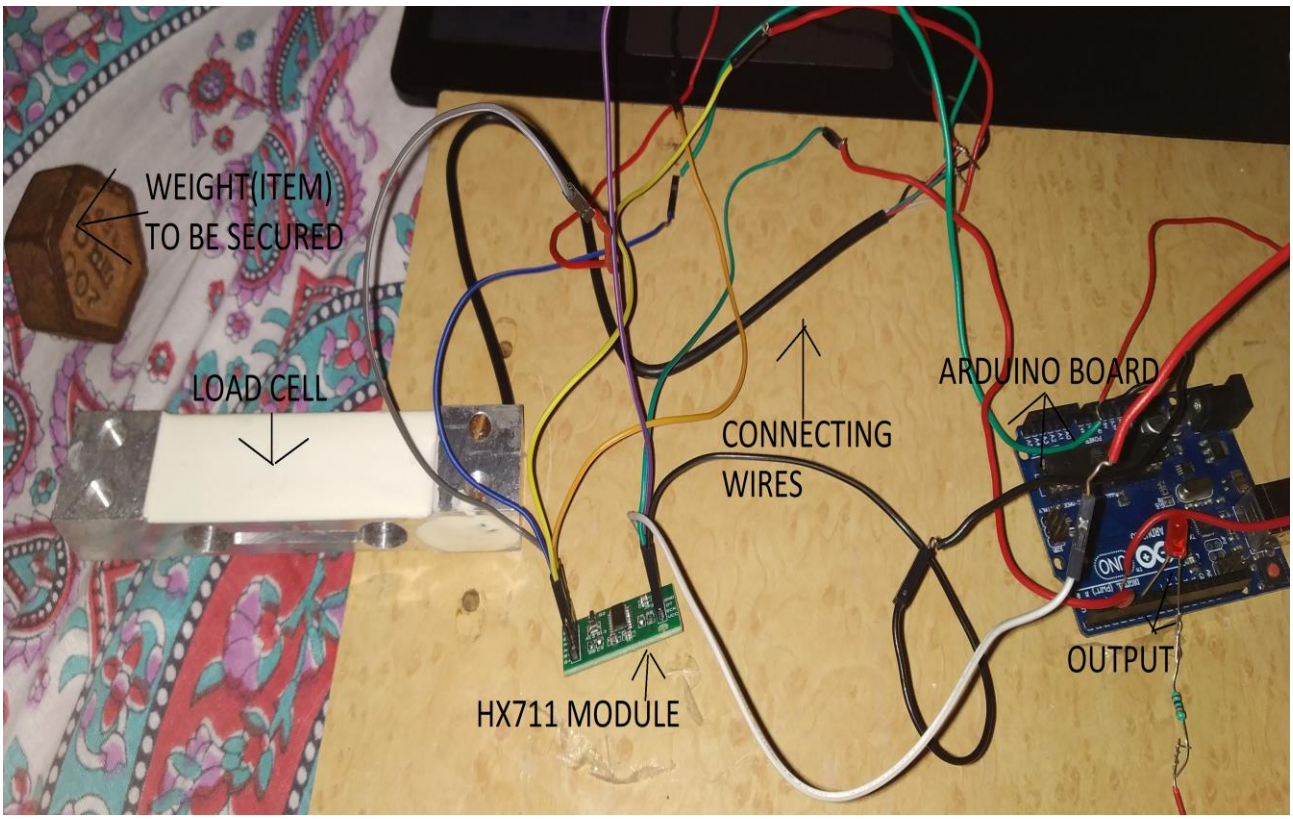

Fig3.9

Chapter 4

Implementation

This chapter presents the methodology of implementation i.e the connections, and the code.

Firstly we placed the load cell perfectly on a wood so that the strain remains perfect on the load cell and error becomes zero and load cell accurately generates low power electrical signal of physical measurable quantity. Then, we connected load cell with HX711 module to convert low power electrical signal to high power electrical signal. As low power input signal gets amplified from module we connected output of HX711 module to ardunio board as an input with connecting vcc, ground, DT, SCK of HX711 module to arduino.

Then the most important part is to calibrate the load cell to get perfect weight. For calibration we used 100gram weight and calibrated the load cell such a way that we get perfect calibration factor for any weight. As calibration was done successfully the final step was to get LED ON as soon as someone touches the proper weight (item need to secure) and tries to pick the weight. To get this output the appropriate code was done on arduino board. The output is perfectly seen through LED. The brightness of LED can be varied using different values of resistors.

4.1 CONNECTIONS:

1. Load cell was placed properly and strongly on a wooden board to maintain the proper strain on the load cell and accuracy of the load cell gets high.
2. Now the input which is a physical measurable quantity and converted to low power electrical signal using load cell and amplified by HX711 module. The connection of this is by connecting red wire, black wire, white wire and green wire of load cell to E+, E-, A- and A+ of HX711 module respectively.
3. Now connect the ground, vcc, DT and SCK pins of HX711 module to ground, 5V, I/O pin 3 and I/O pin 2 of Arduino board.
4. Now connect I/O pin 5 which is output pin of arduino with anode of LED and cathode of LED to ground of arduino via 1K ohm resistor.

4.1.1 Connection diagram:

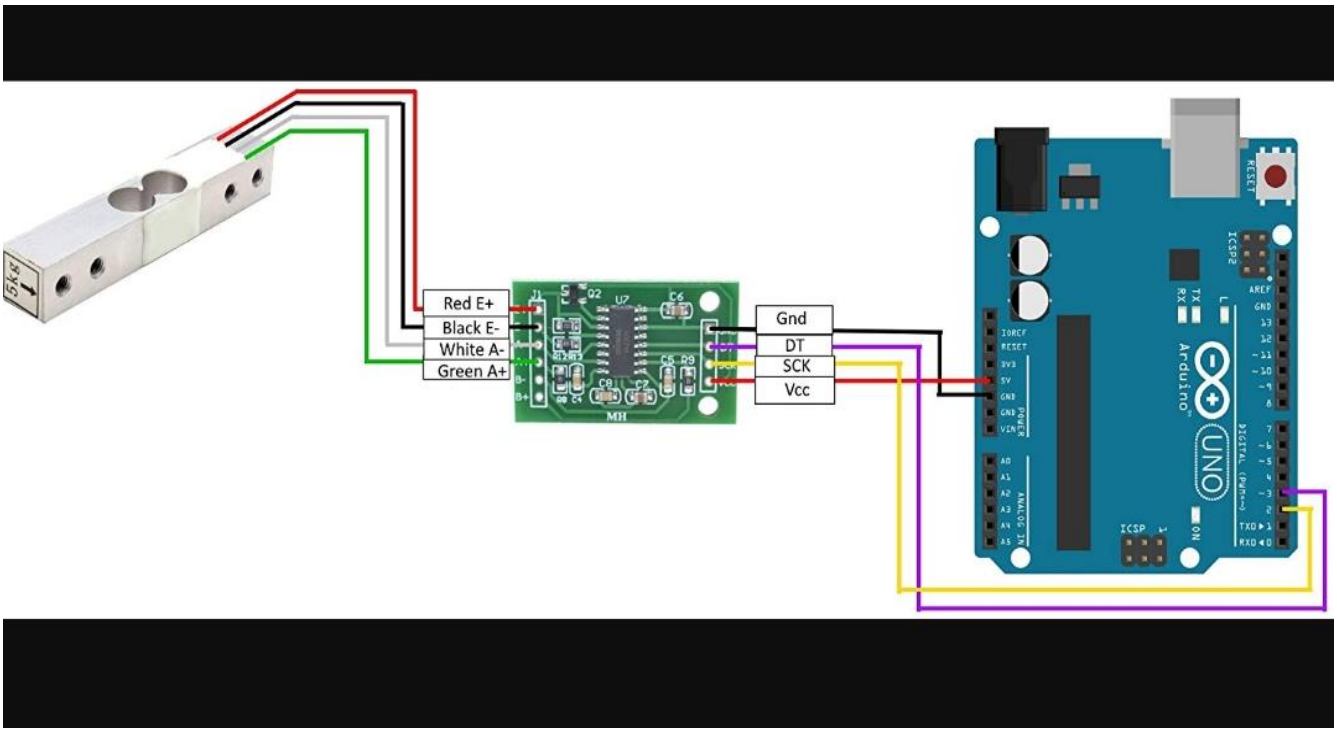

Fig4.1

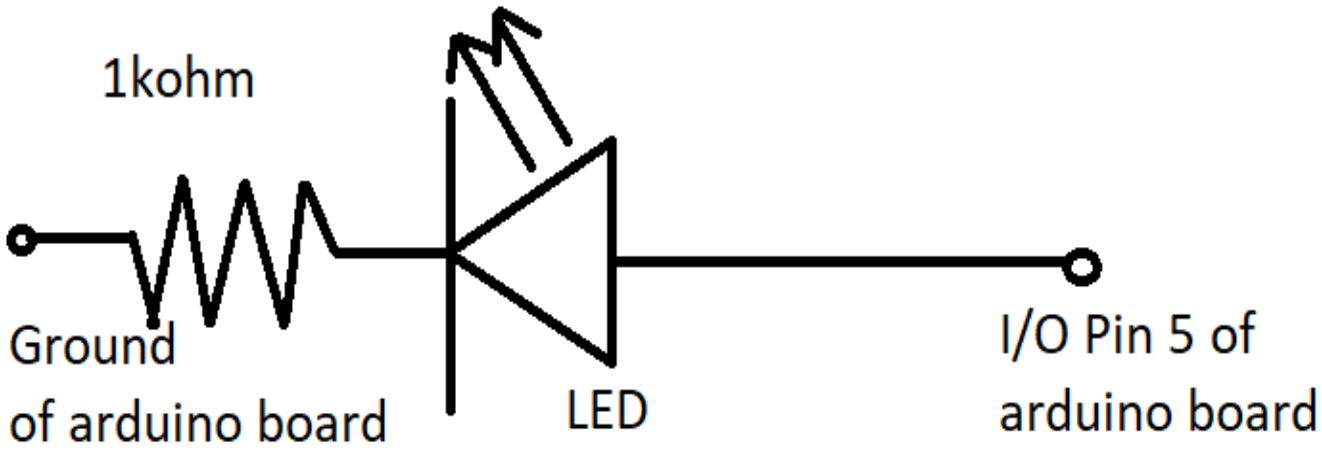

Fig4.2

4.2 CODE:

```
#include <HX711.h>
#define DOUT  3
#define CLK  2
HX711 scale;
float weight;
float calibration_factor =-650000; // for me this value works just perfect -650000
void setup()
{
  Serial.begin(9600);
  scale.begin(DOUT,CLK);

  Serial.println("HX711 calibration sketch");
  Serial.println("Remove all weight from scale");
  Serial.println("After readings begin, place known weight on scale");
  Serial.println("Press + or a to increase calibration factor");
  Serial.println("Press - or z to decrease calibration factor");

  scale.set_scale();
  scale.tare(); //Reset the scale to 0

  long zero_factor = scale.read_average(); //Get a baseline reading
  Serial.print("Zero factor: "); //This can be used to remove the need to tare the scale. Useful in
permanent scale projects.
  Serial.println(zero_factor);
}
void loop()
{
  scale.set_scale(calibration_factor); //Adjust to this calibration factor
  Serial.print("Reading: ");
  weight = scale.get_units(5);
  int y = weight*100;

  if(y == 20 )
  {
    Serial.print(" right ");
    digitalWrite(5,LOW);
  }
  else
  {
    Serial.print(" wrong ");
    digitalWrite(5,HIGH);
  }
```

```
  Serial.print("Kilogram:");
  Serial.print( weight);
  Serial.print(" Kg");
  Serial.print(" calibration_factor: ");
  Serial.print(calibration_factor);

  Serial.println();
  if(Serial.available())
  {
    char temp = Serial.read();
    if(temp == '+' || temp == 'a')
      calibration_factor += 10;
    else if(temp == '-' || temp == 'z')
      calibration_factor -= 100;
  }
}
```

4.3 OBSEVATION:

It was observed that for secured weight of 200GRAMS based on our observation:

SR NO.	WEIGHT	RESULT OBSERVED ON LED
1.	200GRAMS	LED IS OFF
2.	210GRAMS	LED IS ON
3.	000GRAMS	LED IS ON

LED OFF indicates that there is no change in the weight that to be secured and the weight is safe.

LED ON indicates that there is some change in weight that to be secured and someone tries to touch or pick the weight and weight is unsafe.

Chapter 5

Conclusion

This chapter presents the conclusion, result and future scope of the implemented project.

5.1 CONCLUSION:

It was concluded that, as someone tries touch or pick the product which need to secure placed on load cell at that instant the LED turns ON and weight measured is different as compared to secured product weight which alerts the user. Small change in weight alarms the owner.

5.2 RESULT:

As there is any change in the weight that to be secured the LED a turn ON which indicates that someone touch the weight and tries to pick it. If there is no change in the weight the LED remains OFF indicating weight is secured.

Following is the link to the video of our project:

https://drive.google.com/open?id=1AKZ6G0Rf8KcBrAlaxV1uGm6BU4nGkPB7

5.3 FUTURE SCOPE:

- The future work is getting notifications on mobile phone when there is change in weight in load cell as an alarm using IoT.
- Also we can add camera that can shoot the pictures when there is change in weight.
- We can add a sensor to count the number of people visited near the product to see it.
- Even we can add features that can call or message the local police if someone tries to touch or pick the product.
- This can used with such additional features in art galleries, exhibitions, malls, jewelry shops, showrooms, bank lockers and even at home.

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ACKNOWLEDGEMENT

This project would not have been possible without the kind support of many individuals. We would like to extend our thanks to all of them.

We are highly indebted to Dr. ANUDEEPA KHOLAPURE for her guidance and constant supervision as well as for providing information regarding the project, and also for her support in he completion of the project.