TITLE: IOT-BASED SUPPLY CHAIN MANAGEMENT

TEAME NAME: MTY_MICHELL

TEAME MEMBERS

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ABSTRACT

Iron ore is stony sand minerals from which metallic iron ore can be mined economically. Iron usually occurs in the form of magnetite, hematite. It is the most important iron ore found in India, there is a lot of loss of iron ore while traveling from the mines to the end points, and it is difficult to manually classify the types of iron ore and the process takes a long time. To overcome these problems, we use advanced RFID technology with weighbridge tracking system and use GPS tracking system for transportation. For the classification of iron ore species, we use a preliminary object identification algorithm - YOLO V5. An approach to iron ore classification based on the visual texture of the ore particles, which changes with mineral content, has been proposed. For example: hematite, pellets, magnetite vary in color and shape. These graded iron ores travel on a conveyor belt with RFID tags through the mill. The RFID reader reads the tag and sends the data to the microcontroller for further tracking. Classified iron ore is loaded into trucks sealed with an RFID tag, and a GPS tracker is used to capture and track the vehicle on the IOT dashboard. The weight is also monitored by a load cell. Tracked and monitored data will be stored and displayed in the thinger.io dashboard. This is a new idea for the problems faced in the mines, which can be fixed by the above technique

Keywords: RFID, GPS, YOLO V5 algorith

CHAPTER 1 INTRODUCTION

1.1 CAUSE OF TRACKING IRON ORE

India is rich in iron ore. A place where ores occur in different strata. However, the most important economic iron deposits are associated with the banded iron beds of Precambrian volcanic deposits. Hematite and magnetite are the major iron ores in India. Of these, hematite is the most important iron ore which contain iron oxide Fe2O, consumed by the country's steel and iron industry because of its high-grade and tough properties. These are supplied to the steel industry through many processes that separate type and quality. At iron ore mines, truck transportation is a major source of iron ore loss, and the sorting of iron ore types is done manually in laboratories on a belt conveyor after the separation process. There are many errors, and the accuracy is poor. To overcome these problems, we use advanced image processing and tracking systems.

Our ore tracking system uses RFID technology to track packages of ore from mine to plant and beyond. RFID is a revolutionary system that uses RFID tags, detectors and proprietary dashboards to track ore throughout the mining process. Detection points are located at major ore processing sites. This technology does not require an internal power supply, but the label has a longer shelf life. An approach has been proposed to classify iron ores based on the visual texture of the ore particles, which differ by mineral content.

For example: hematite, pellets and magnetite have different colours and shapes. Iron ore classification uses YOLO V5 image processing, an advanced object detection algorithm. This allows you to understand how different ores affect mine and factory operations and final products. GPS trackers are also used to track the location of vehicles transporting ore from sellers to buyers. An additional bridge system is used to calculate the weight of iron ore from each toll booth.

RFID can also be used to track products through the entire transportation chain (road, rail, port) from mine to final customer. This is especially important for the iron ore business where product marketing and supply logistics are often complex. By tagging and tracking all properties, plant operations can be optimized, sorted, blended and homogenized to maximize final product value. A nodeMCU esp8266 microcontroller is used to transmit sensor data to his IoT platform via Wi-Fi technology. An LCD is used to display the weight of the iron ore using the I2C protocol.

The system also provides more precise coordination, enabling tracking and optimization of product delivery and shipping logistics. The iot platform thinger.io is used to display the above sensor data as a graphical representation. Receive regular reports on process performance and recommendations on actions to take.

1.2 AIM OF THE PROJECT

To develop the mini prototype of iron ore tracking and monitoring from mines to end points by thinger.io IOT platform. To prevent the loss of iron ore in transporting by using RFID and GPS tracker and classifying the iron ore types through image processing YOLO V5.

1.3 OBJECTIVE OF THE PROJECT

The main objective of the iron ore tracking system is

- To monitor and track the iron ore from mines to mills by using RFID
- To prevent the loss of iron ore while transporting from mills to suppliers with GPS tracking system.
- To calculate the weight of the iron ore and prevent the loss from source to destination by using the load cell and HX711

- To classify the iron ore types by using the image processing YOLO V5
- To develop a smart tracking system and weight bridge with help of Thinger.io platform.

1.4 SCOPE OF THE PROJECT

- This project can be implemented to the iron ore mines and coal mines for tracking the mineral while travelling in conveyor belt and transporting from mines to end points.
- An advance object detection algorithm and low accuracy of laboratory testing.
- The mines industry operator can monitor and track the complete process from anywhere through thinger.io dashboard
- Advance IOT weight bridge system is used to measure the weight of the iron ore from mines to end points.

CHAPTER 2

LITERATURE SURVEY

S.NO	TITLE	OBJECTIVES	AUTHORS
1.	"Traceability in Iron Ore Processing and Transports"	To track and trace products in a in the transportation chain from supplier to customers is important for quality control and process improvements. In this there using low frequency RFID tag to track.	Bjarne Bergquist (2018)

2.	"The iron ore pellet distribution chain using active RFID technology"	RFID pellets follow transport ation and measure acceleration and temperature. RFID exciter and readers were installed downstream in a harbor storage site to retrieve data. Here separation of iron ore is done with manpower and low accuracy.	Bjarne Bergquist (2019)
3.	"Transportation Of Ungava Iron Ore"	Slowness in developing the region, in large measure, to difficulty of access, particularly in winter. This has been reflected in high transportation costs. RFID is used and GPS with high power operating.	TREVOR LLOYD (2016)

4.	"Reducing Production and Transportation Costs for the Transportation of Iron Ore Raw Materials from Mining and Processing"	The transportation allows to distribute the ores of transportation along routes. To determine the volume of transportation to temporary storage points, transportation route, assign the required number of dump trucks. But tracking is unstable.	A N Novikov N A Zagorodnij (2019)

5.	"A review of the newly developed method used to prevent liquefaction of iron ore fines on bulk carriers"	Incidents which involving bulk carriers transporting iron ore fines has initiated research and implementation of new test method used to determine transported without being at risk. Transporting of iron ore is not correctly processed with that solution.	Michael Munro Abbas Mohajerani (2016)

CHAPTER 3

IRON ORE TRACKING SYSTEM

3.1. PROBLEM STATEMENT

To develop innovative technology to analyses the various levels of mines while also ensuring the tracking of raw minerals from mines to endpoints.

- A smart system that monitors the transport and movements of various types of minerals from mines to endpoints.
- Prevention of leakage of iron ore while transporting
- To classify the iron ore types with manpower using laboratory testing is low accuracy
- The misclassification of types of iron ore with other mineral types.

3.2. HARDWARE REQUIRMENTS

- NodeMCU [ESP8266]
- Load cell[40kg]
- HX711
- GPS module [Neo 6M]
- LCD [16*2]
- I2C module
- RFID reader [EM-18]

- Adapter [12 V 2 A]
- Lithium-ion battery [12 V 2500mah]
- voltage regulator [7805]
- RFID tag [125KHz]
- LED [red]
- Resistor [1k]

3.2.1. NODEMCU (ESP 8266 - 12 E)

NodeMCU is an open-source firmware for the IOT platform. It is based on the Lua andembedded programming language. We have chosen the ESP8266 because it has an inbuilt WIFI module in it whereas other microcontrollers do not have an inbuilt WIFImodule. The cost of ESP8266 is very low when compared to Raspberry pi and other devices. It is commonly used in manufacturing of embedded applications for the development of Internet of Things. It follows TCP/IP protocol.

- Internal Memory -32KB
- 17GPIO pins
- Frequency-2.4to2.5GHz.
- OperatingVoltage-3.3V
- Clock Speed -80/160MHZ
- Connectivity-IEEE802.11b/g/nWi-Fi
- Antenna Type-PCB
- Flash Memory-4MB

Fig 3.1: Nodemcu Esp8266-12E

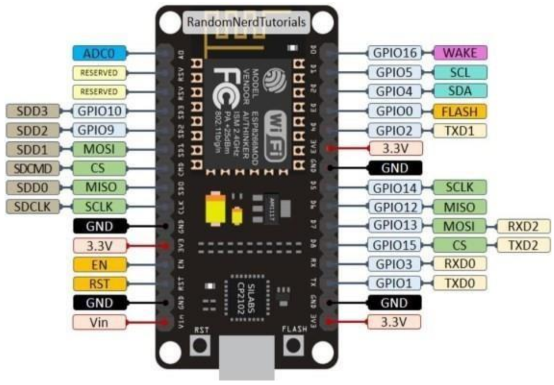


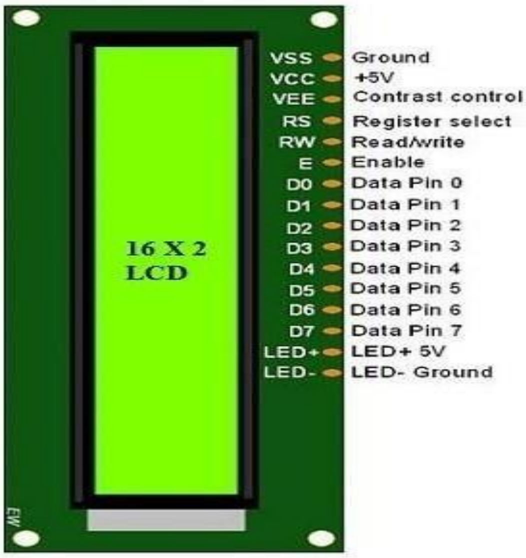
Fig 3.2: Pin description of Esp8266 Wi-Fi module

3.2.2. LCD DISPLAY

LCD (Liquid Crystal Display) is a type of flat panel display that operates primarilywith liquid crystals. As they are most probably found in smartphones, televisions, computer monitors, and instrument panels, LED have more number of consumers and leads to wide range of business application.

- Module - LCD
- Operating Voltage - 4.7-5.3V
- Operating current - 1 mA
- Rows - 16 Characters
- Pixels - 5x8
- It has two modes - 4bit & 8 bit

Fig 3.3: LCD display



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3.2.3. RFID READER (EM 18)

RFID stands for Radio Frequency Identification. It mainly uses the electromagnetic waves which is used foe automatic identification and the tags attached to objects were easily tracked by the RFID. In RFID there is a small radio transponder, and it also contains radio receiver and transmitter. When RFID card reader is been triggered by the electromagnetic pulse, the digital data is been transmitted by the tag which is used to identify the inventory number and it returns to the reader. There are two kinds of tags namely active tags and passive tags. The passive tags are charged by the radio waves from the RFID card. The active tags are charged by the battery. RFID is most used for automatic identification and data’s can be automatically captured.

- Operating voltage - 4.5v
- Operating frequency - 25KHz
- Maximum current - 50Ma
- Distance - 10cm
- Operating temperature - 80^{o} c
- Communication parameter - 600bps

Fig 3.5: RFID Reader

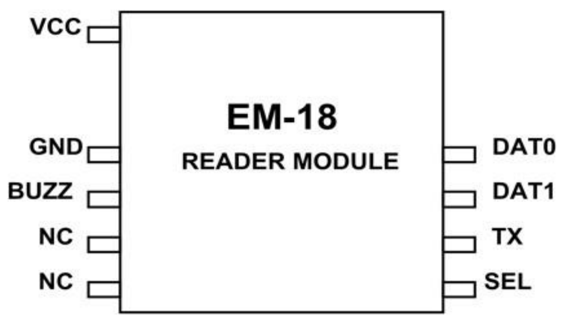

Fig 3.6: Pin description of EM18 - RFID Reader

Fig 3.7: RFID card

3.2.4. LOAD CELL

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells. The electrical signal output is typically in the order of a few millivolts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer is plugged into an algorithm to calculate the force applied to the transducer.

- Module - load cell
- Input voltage - 5V
- Rated Load - 40Kg . Max
- Type - single point load cell

Fig 3.8: Load cell

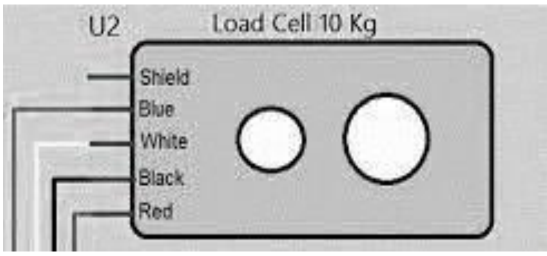

Fig 3.9: pin description of Load cell

3.2.5. HX711

The HX711 is a precision 24-bit analog-to-digital converter (ADC) designed for scale and industrial control applications for direct interface with a bridge sensor. It is specially made to amplify signals from cells and report them to another microcontroller. The HX711 uses a two-wire interface (clock and data) for communication. All GPIO pins of the microcontroller should work and many libraries have been written to make it easy to read data from the HX711. The load cells use a 4-wire Wheatstone bridge to connect to the HX711.Module – HX711

- Operating voltage – 5V
- Current consumption – 1.5mA
- Resolution – 24 bit

Fig 3.10: HX711

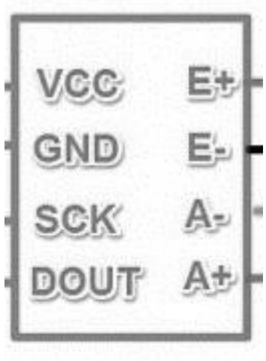

Fig 3.11: HX711 pin description

3.2.6. GPS module

It can track up to 22 satellites over 50 channels and achieves the highest level of tracking sensitivity, i.e. -161dB, with a current consumption of only 45mA. Unlike other GPS modules, it can perform 5 position updates per second with a horizontal position accuracy of 2.5m. GPS is used to track the position of a vehicle by displaying the latitude and longitude of a given point using an antenna.

- Module – Neo 6M
- Operating voltage – 3.6V
- Current consumption – 45mA
- Chip – NEO 6

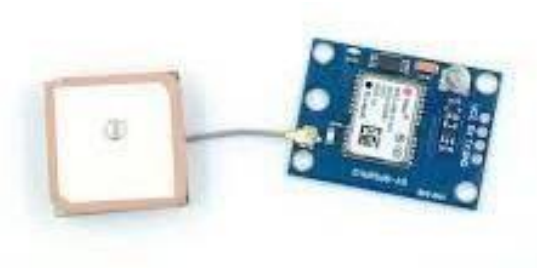

Fig 3.12: GPS module

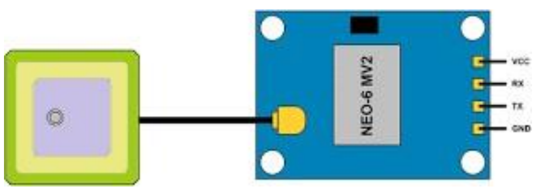

Fig 3.13: Pin out of GPS module

3.2.7. I2C module

I2C Module has an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version you have check the black I2C adaptor board on the underside of the module.

- Module – I2C
- Operating voltage – 5V
- Current consumption – 45 mA
- I2C - PCF8574

Fig 3.14: I2C module

Fig 3.15: Pin out of I2C

3.2.8. 7805

Voltage regulators are very common in electronic circuits. They provide a constant output voltage for varying input voltages. In our case, the 7805 IC is an iconic regulator IC that finds its application in most projects. The name 7805 has two meanings, "78" means it is a positive voltage regulator and "05" means it provides 5V as output. So our 7805 will provide an output voltage of +5V.

- Type – heat sink type
- Input voltage – 30V
- Current – 1A
- Output voltage – 5V

Fig 3.16: 7805

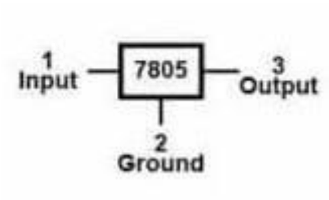

Fig 3.17: Pin out of 7805

3.2.9. LED

A light-emitting diode is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

- Light – LED
- Operating voltage – 2V
- Current consumption – 10 mA
- Colour – Red

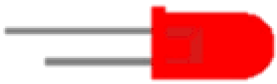

Fig 3.18: LED

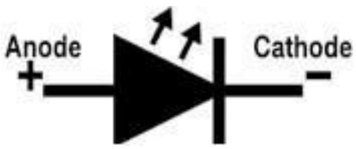

Fig 3.19: Pin out of LED

3.3. SOFTWARE REQUIREMENTS

- Arduino IDE
- Thinger.io

3.3.1. ARDUINO IDE

Arduino IDE (Integrated Development Environment) may be a software application which will be written in C, C++ and Lua languages. It's an IoT development environment that's all-in-one. It not only supports Arduino boards, but also Raspberry Pi, ESP32, ESP8266, and a range of other boards. The IDE has all of the expected capabilities, likecode completion and then forth. It contains a text editor for writing programming function, console is for showing output and detecting the detailed information aboutthe errors. Program that are written in Arduino Software is termed sketches. These sketches were created with a text editor and saved with the .ino file extension. we've gotto incorporate library files for Nodemcu and Arduino.

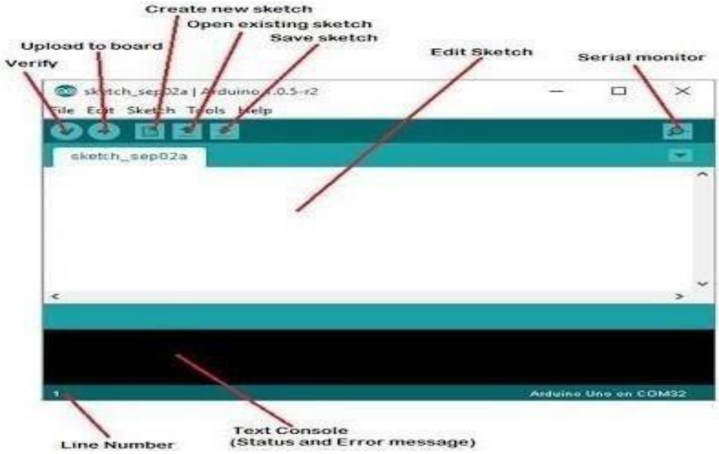

Fig. 3.20: Arduino IDE

3.3.2. THINGER IOT DASHBOARD

Thinger.io is a cloud-based IoT platform that provides all the necessary tools for prototyping, scaling and managing connected products in a very simple way. Our goal is to democratize the use of IoT, make it available to the whole world and streamline the development of large IoT projects. Just a few lines of code to connect a device and start loading data or controlling its functions with our web console that can easily connect and manage thousands of devices. Any device from any manufacturer can be easily integrated with the Thinger.io infrastructure. The IoT server subscribes device resources to retrieve data only when necessary, a single instance of Thinger.io can manage thousands of IoT devices with low computational load, bandwidth and latency.

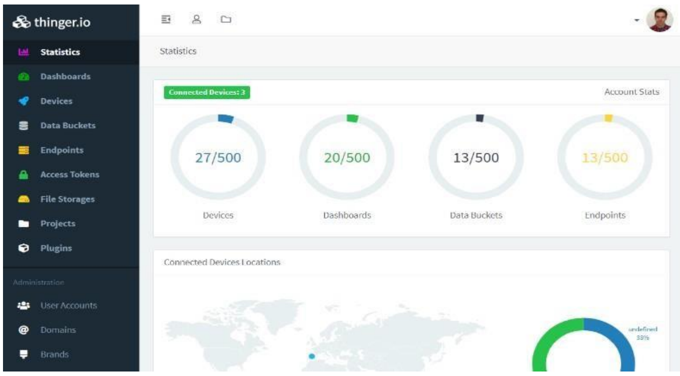

Fig. 3.21: Thinger.io platform

3.4. BLOCK DIAGRAM

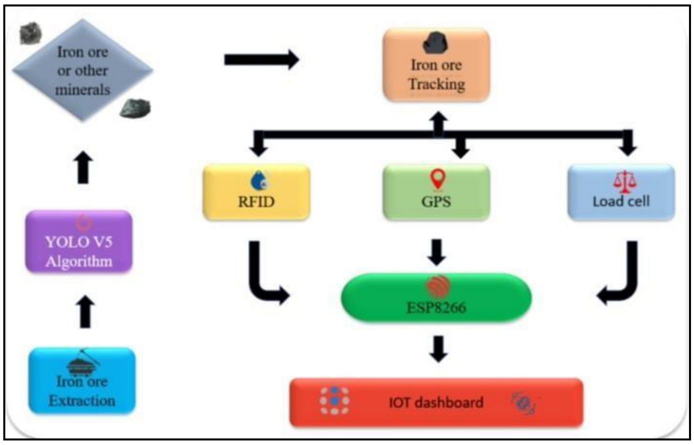

Fig. 3.22: Block diagram of the idea implemented

3.5. METHODOLOGY

In the mines the iron ore extraction is done at the first stage and travel through conveyor belt. In second stage the image processing is used to classify the iron ore types like hematite, magnetite, or pellets. An approach has been proposed to classify the ores for iron, based on the visual texture of the ore particles. The visual texture of ore particles varies with the mineral contents. For example: hematite, pellets, magnetite are different in color and shape. to classify the iron types we used and advance objection detection algorithm of YOLO V5 algorithm. These classified iron ores travel in conveyor belt with the RFID tags through mill. The RFID reader will read the tag and send the data to the microcontroller for further tracking processing. Then the iron ore are filled in trucks with sealed with RFID tag and GPS tracker is used to tack and monitor the vehicle in the thinger.io dashboard. The weight of the iron ore is also measured with the HX711 amplified load cell and monitored in the thinger.io dashboard. The microcontroller used here is ESP8266 also said to as Node MCU which is used to send data through IOT dashboard over Wi-Fi . The user can login with the Dashboard, track and monitor the mines process from the control room. According to our problem we are classifying the types of iron ore using image processing by YOLO V5 algorithm with high accuracy. It is an accurate object detection algorithm. The classified iron ore is tracked using RFID and GPS tracking system also the weight is monitored by load cell. These is a new idea for the problems facing in the mines which can be rectified by the above technique.

3.6. ALGORITHM

Step 1: First, we must turn on the main power supply.

Step 2: After it we initialize the LCD and Arduino.

Step 3: We include required library files in Arduino ide software.

Step 4: Network connections should be made.

Step 5: Provide username and password for mobile hotspot.

Step 6: Hardware connection should be made and given power supply. Step 7: Pairing the thinger.io device id and microcontroller using Wi-Fi technology.

Step 8: If the Wi-Fi connection is made then a thinger.io platform is prepared.

Step 9: tracked location of tag has been done through RFID.

Step 10: Reads the weight of the object in the load cell and displays the units on the LCD.

Step 11: The consumed weight was passed to the nodemcu board and displayed on Lcd display and thinger.io web.

Step 12: The location is displayed by the GPS module by the sending the latitude and longitude degree.

3.7. FEASIBILITY ANALYSIS

The feasibility analysis of our project is to overcome the drawbacks of the existing solution of tracking and monitoring of iron ore mines

- The tracking and monitoring system of iron mines can be implemented by using GPS and RFID linked with IOT platform
- The weight of the iron ore can be measured by HX711 load cell also linked with IOT dashboard
- The classification of iron ore can be done by YOLO V5 algorithm which is a best object detection algorithm
- The software we used here is Arduino IDE and thinger.io for monitoring the process
- The system efficiently operates & reduces manual computation and time of processing, reducing cost of paperwork and human errors.

3.8. APPLICATIONS

Iron ores are rock sand minerals from which metallic iron can be economically extracted. The iron is usually found in the form of magnetite (Fe3O), 72.4%Fe, hematite (Fe2O). These are the most prominent of the iron ores found in India. India faces many difficulties for track and monitor these iron ore from mines to end points.

Heavy losses occur while transporting the iron ore from mines to end-points

The labor requirement is more and long-time process in classify the iron ore types and sometimes errors may occur

Theft of vehicles & ore while transporting the iron ore from source to destination

These cons can be rectified by using the RFID and GPS tracking system and load cell HX711. For classifying the iron ore types we use YOLO V5 algorithm.

3.9. ADVANTAGES

1. The operators can easily monitor the complete tracking process of the iron ore from the control room by using the thinger.io dashboard.
2. It also enables continuous monitoring and comparison through graphs.
3. The image processing with YOLO V5 is implemented for classify the iron ore types.
4. Reduce the leakage of the iron ore while transporting.
5. RFID and GPS tracker is used to track and trace the iron ore.

Table No 1. RFID tag with dashboard pre-programmed

RFID TAG	PLACE	LOCATION COLOUR	SL.NO
TAG 1	SATHYAMANGALAM	PINK	101
TAG 2	PULIYAMPATTI	BLUE	625
TAG 3	ANNUR	GREEN	314
TAG 4	GANDHIPURAM	RED	971

CHAPTER 4
CODE

4.1. Program

```
#define THINGER_SERIAL_DEBUG
#include <ThingerESP8266.h>
#include <ESP8266WiFi.h>

#define USERNAME "sridhar_3361" // user name of thinger iot
#define DEVICE_ID "nodemcuUltrasonic1" // device id of thinger iot
#define DEVICE_CREDENTIAL "9659@6382" // password of device thinger iot

ThingerESP8266 thing(USERNAME, DEVICE_ID, DEVICE_CREDENTIAL);

#define SSID "IOT" // hotspot name
#define SSID_PASSWORD "IOt12345" // hotspot password



#include <HX711_ADC.h> // need to install
#include <Wire.h>
#include <LiquidCrystal_I2C.h> // need to install


HX711_ADC LoadCell(D5, D6); // parameters: dt pin 6, sck pin 7;
LiquidCrystal_I2C lcd(0x27, 16,2);



int barak = 0;
String jarak;
String i; int
grt;
int count = 0;  // count = 0 char input[12];
// character array of size 12 boolean flag =
0;
```

```
void setup() {
  Serial.begin(9600);
  WiFi.begin(SSID, SSID_PASSWORD); thing.add_wifi(SSID,
  SSID_PASSWORD);
  LoadCell.begin(); // start connection to HX711
  LoadCell.start(2000); // load cells gets 2000ms of time to stabilize
LoadCell.setCalFactor(120); // calibration factor for load cell => dependent on your
individual setup lcd.init(); lcd.backlight(); thing["ultrasonic"] >> [](pson& out){
    out["barak"] =barak;
    out["jarak"] =jarak;
    out["grt"] =grt;
    };
}

void loop() {
  thing.handle();
  LoadCell.update(); // retrieves data from the load
  cell float t = LoadCell.getData(); // get output value
  lcd.setCursor(0, 0); // set cursor to first row
  lcd.print("Weight[g]:"); // print out to LCD
  lcd.setCursor(0, 1); // set cursor to second row
  lcd.print(t); barak = t; if(Serial.available())
   { count = 0; while(Serial.available() && count < 12)          // Read 12 characters and
      store them in
input array
      {
        input[count] =
        Serial.read(); count++;
        delay(5);
      }
     Serial.println(input);                              // Print RFID tag number
```

```
if(input[9]=='0' && input[10]=='6' && input[11]=='5')
{
  String a="REACHED GANDHIPURAM";
  i = a; grt = 1;
  Serial.print("LOCATION 1");
} else if(input[9]=='6' && input[10]=='8' &&
input[11]=='E')
{
  String b="REACHED ANNUR";
  i = b; grt
  = 2;
  Serial.print("LOCATION 2");
} else if(input[9]=='6' && input[10]=='A' &&
input[11]=='5')
{
  String c="REACHED PULIYAMPATTI";
  i = c; grt = 3;
  Serial.print("LOCATION 3");
} else if(input[9]=='1' && input[10]=='0' &&
input[11]=='B')
{
  String d="REACHED SATHYAMANGALAM";
  i = d; grt = 4;
  Serial.print("LOCATION 4");
}

} jarak =
i;
}
```

CHAPTER 5

RESULT AND DISCUSSION

Fig. 5.1: Product image of Iron ore tracking

Fig. 5.2: Iron ore tracking with weigh bridge

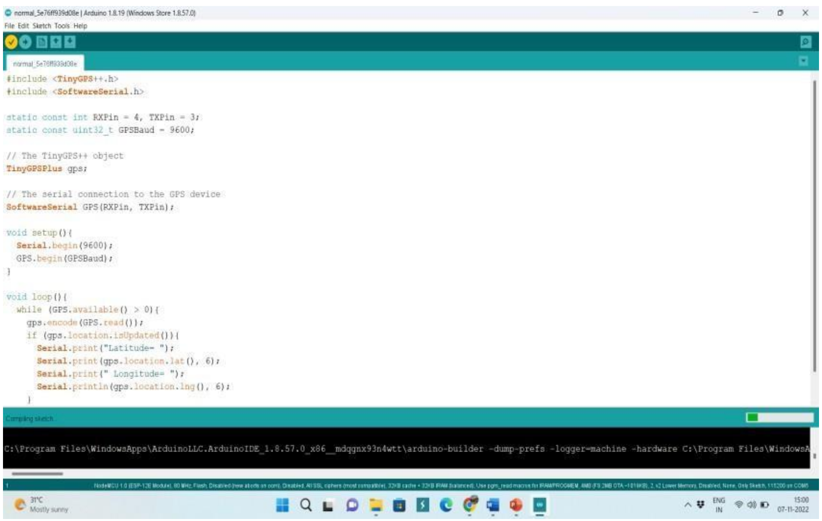

Fig. 5.3: Programming the NodeMCU with Arduino IDE

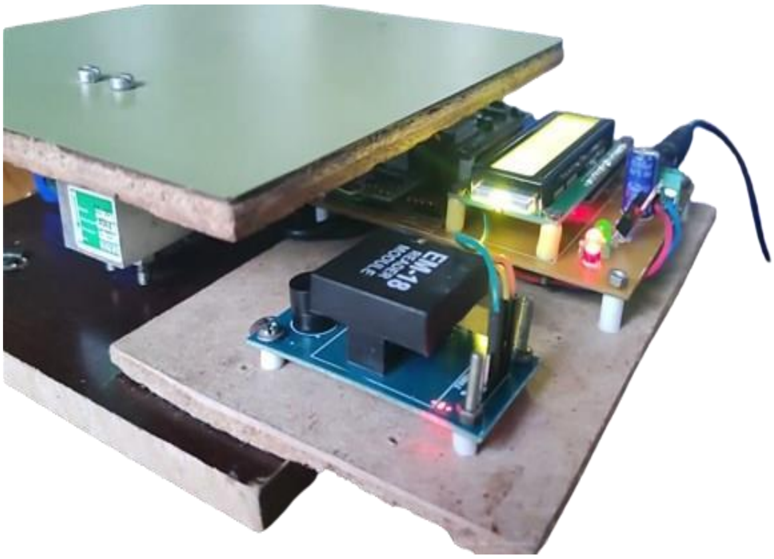

Fig. 5.4: Initially when we give power supply to microcontroller and LCD will load the starting calibration.

Fig. 5.5: when we place any object on the load cell the lcd display the weight

Fig. 5.6: Scanning the RFID tag

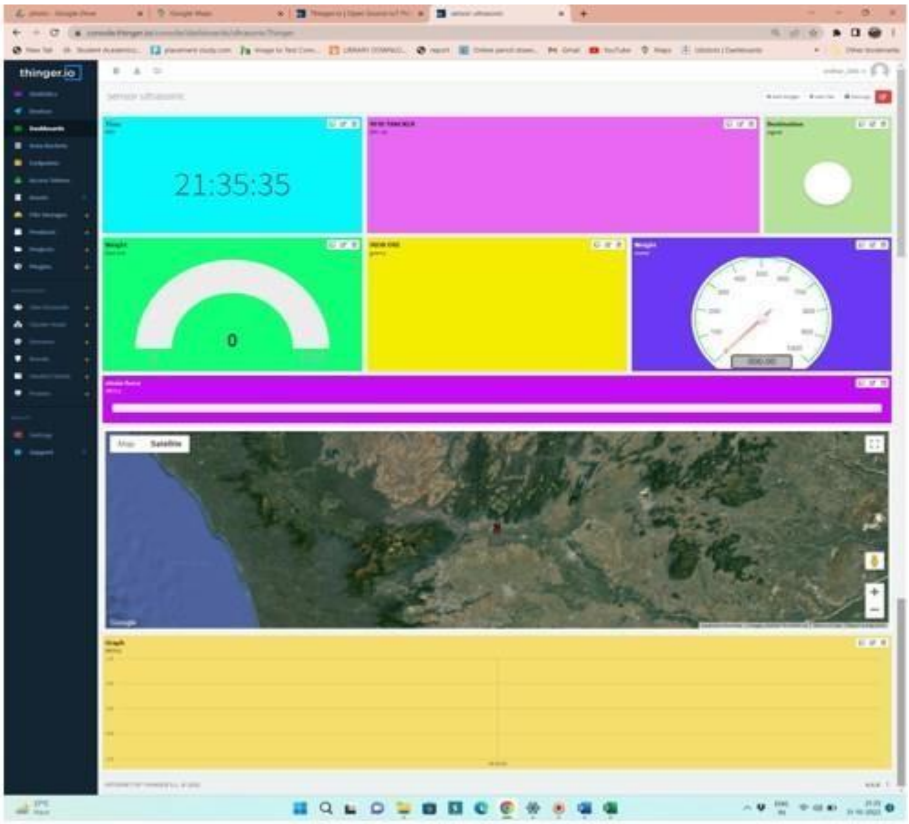

Fig. 5.7: Initially the thinger.io dashboard will be empty when no device connected

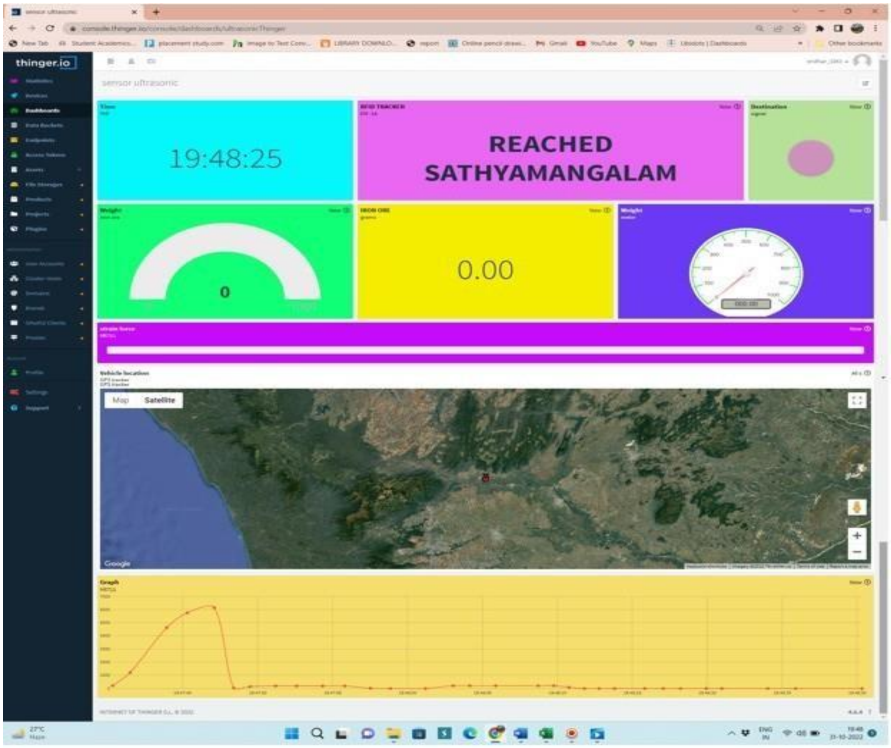

Fig. 5.8: The thinger.io dashboard display value when the device connected with Wi-Fi

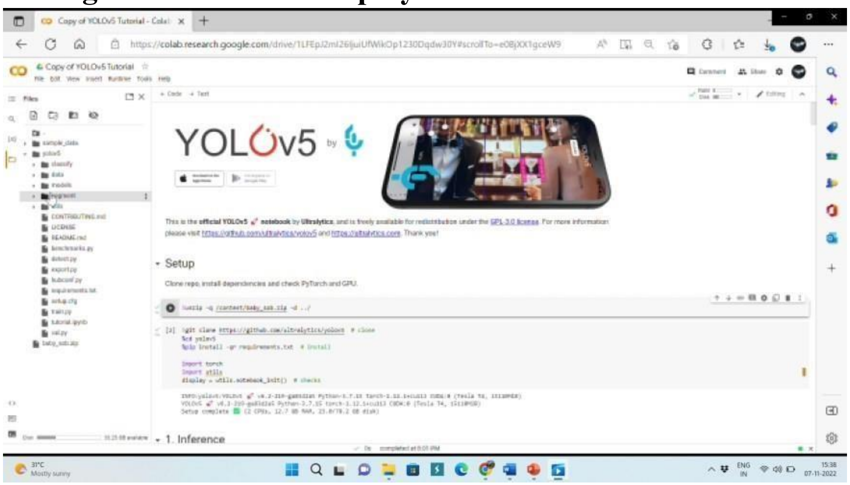

Fig. 5.9: YOLO V5 coding with web

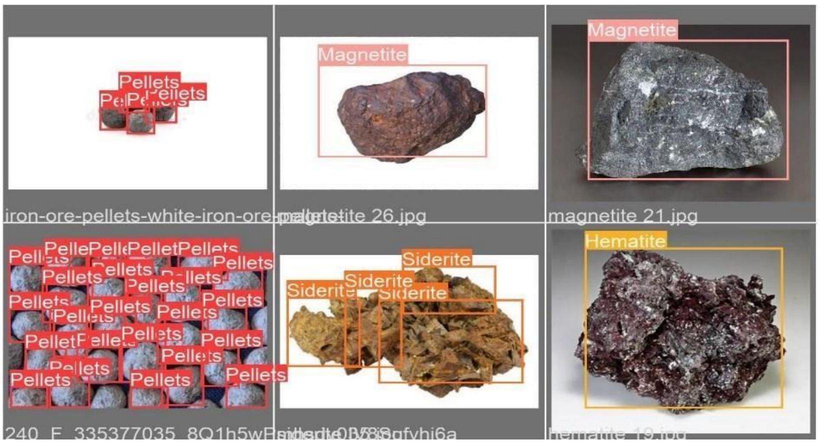

Fig. 5.10: YOLO V5 Output of iron ore classification

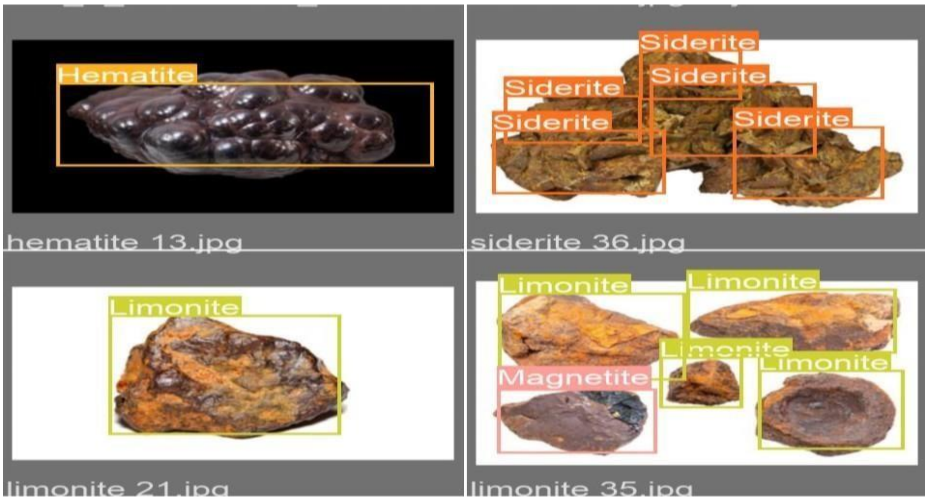

Fig. 5.11: YOLO V5 uploading the images in drive

5.1. RESULT

The monitored data will be displayed in the Thinger.io dashboard and the data will be stored in the events of the thinger.io platform. The RFID tag data will be displayed in the RFID tracker box of the dashboard and the led will blink in the appropriate color based on the location standard. The load cell data will be displayed in the gauge meter and tachometer, approximate value is also displayed in the Thinger.io dashboard with graph plots. The wifi must be always connected with the microcontroller for transferring the data of the sensors for every 5 seconds.

5.2. DISCUSSION

The implemented idea of the iron ore tracking, and monitoring is done by using the RFID and GPS tracker system with calculating the weight measured by the load cell. The iron ore classification is done by the YOLO V5 algorithm by upload the images in the YOLO platform. The YOLO will classify the images by pre-defined data and the output shown by the dashboard and the text is displayed as hematite and magnetite or pellets. The YOLO V5 algorithm is very accurate and good object detection algorithm. In real time implementation, the image processing can be done by using a high-quality camera with Raspberry Pi for advance image classification. If any other minerals found in the conveyor belt, an alarm will indicate and the robotic arm will pull down the other minerals to a bin. Here the RFID frequency is 125Kz for reading the tag which travel in the conveyor belt. In future the lore module and Lora WAN can be used for transferring the data from the sensors, mines to the control room for long range without any data loss or any lag in transfer speed.

CHAPTER 6 CONCLUSION

India is very rich in iron ore extraction and production of steels. The government and private mines industry are facing the big challenges in tracking and monitoring the iron ore in industry and while transporting the iron ore from source to destination. To rectify these problems, the above idea will be helpful in the tracking and classification of iron ore with the help of objection identification algorithm. The tracking processing can be done by RFID and GPS tracker system with inbuilt load cell-based weigh bridge for calculating the weight of the iron ore. The best free IOT platform, Thinger.io, is used for displaying the data in the dashboard. The operator or manager of the mine industry can see the complete tracking process from the thinger.io dashboard. The transferring of data from sensors to the IOT platform is done by the Wi-Fi. In future, the Lora WAN can be used for long range transmission of data without any loss. The power consumption of the above product is very less and give accurate results. Easy to be implemented in the real time system.

REFERENCES

1. Bhaskar, K., Murthy YR, Raju, M., Tiwari, S., Srivastava, J., Ramakrishnan, N., CFD simulation and experimental validation studies on hydrocyclone. MINER. ENG., 2007, 20(1), 60-71.
2. Cox, R., Smith, J., Dimitratos, Y., Can simulation technology enable a paradigm shift in process control? Modelling for the rest of us. COMPUT. CHEM. ENG., 2006, 30(10-12), 1542-1552.
3. Donohue, D., Strengthening IAEA safeguards through environmental sampling and analysis. J. ALLOY. COMPD., 1998, 271-273 (12), 11-18.
4. Finnie, G., Kruyt, N., Ye, M., Zeilstra, C., Kuipers, J., Longitudinal and Transverse Mixing in Rotary Kilns: A Discrete Element Method Approach. CHEM. ENG. SCI., 2005, 60(15), 4083-4091.
5. G. Gustafsson, H. Häggblad, P. Jonsén, M. Nishida High-Rate Behaviour of Iron Ore Pellet, Proceedings from DYMAT 2015 - 11th Int. Conf. Mech. Phys. Behav. Mater. Dynam. Load, 94, 05003, September 7–11 (2015)
6. M. Nabeel, A. Karasev, P.G. Jönsson Evaluation of dust generation during mechanical wear of iron ore pellets ISIJ Int., 56 (2016), pp. 960-966
7. J.A. Halt Controlling Properties of Agglomerates for Chemical Processes, Thesis Michigan Technological University (2017)

REVIEWER COMMENTS AND QUERIES FROM ZEROTH REVIEW

- Reviewer suggested us to make more investigation on the research papers that related to our project.
- They suggested to make a survey on more literature related to our project.

REVIEWER COMMENTS AND QUERIES FROM FIRST REVIEW

- Reviewer suggested us to do a complete block diagram of the idea implemented.
- They suggested to make some new innovative related to the idea implemented.

REVIEWER COMMENTS AND QUERIES IN SECOND REVIEW

- During second phase reviewer suggested to demonstrate our project with a working video.
- Reviewer also suggested to complete the results and discussion part and design part since we haven't attached the results during second revi