e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 13, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.317

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

Intelligent Load Guard: IoT-Based Truck Tilt and Load Management System

Aditya M. Chougale, Suraj C. Desai, Shubham M. Ballal ,S.R.Desai

Department of Electronics and Telecommunication Engineering, Sant Gajanan Maharaj College of Engineering, Mahagaon, India.

ABSTRACT: The project "Intelligent LoadGuard: IoT-Based Truck Tilt and Load Management System" presents a state-of-the-art method designed to transform operational effectiveness and truck safety. This clever solution makes use of Internet of Things technology to keep an eye on and stop cargo-related mishaps and truck tilting caused by overly or unevenly loaded trucks. The system provides real-time insights into load distribution, vehicle inclination, and position by integrating GPS tracking, tilt and stability sensors, and load sensors. In addition to offering the option to remotely regulate the truck's ignition in the event of instability, it is intended to quickly warn drivers and fleet management of potential hazards. In addition to improving safety and cargo protection, the initiative optimises routes, lowers operating costs, and promotes environmental responsibility. Eventually changing the industry's requirements for truck safety and management

KEYWORDS: IoT, Truck tilt, Load management

I. INTRODUCTION

An innovative reaction to the pressing issues facing the transport and logistics sector. An ongoing safety concern for many years, truck rollovers brought on by over- or uneven-loading have the potential to cause serious accidents, damage to goods, environmental risks, and large financial losses. Using cutting-edge IoT technology, this project provides real-time monitoring and management of truck tilt and cargo load distribution because it recognises the need for a proactive solution.The system provides fleet managers and truck operators with an extensive tool set for guaranteeing the safety and stability of their trucks by merging GPS monitoring, tilt and stability sensors, and load sensors combined. Additionally, the project's innovation includes load measurement, providing the option to remotely manage the ignition in the event of instability. The "Intelligent Load Guard" project proposes a transformative step towards a safer, more effective, and environmentally conscious truck management system with the ability to lower accidents, optimise operations, and improve compliance with safety regulations.

II. LITARATURE REVIEW

1. Carlo Edoardo Campanella, Vittorio M. N. Passaro, Lorenzo Vaiani, Martino De Carlo, and Antonello Cuccovillo, Gyroscope Technology and Applications: A Review from an Industrial Perspective. An overview of contemporary gyroscopes and their functions according to applications is provided in this study. Both macro- and micro-scale mechanical and optical gyroscopes are among the gyroscopes under consideration. Over time, drift can occur in gyroscopes, resulting in measurement mistakes. This is especially troublesome for apps that take a long time.
2. Leo Louis, "Using Arduino as a tool for study and research: its working principle," IJAER Volume-13, (2018)This essay examines the functions and uses of an Arduino board.The study demonstrates the memory and processing capacity limitations of Arduinos.
3. International Journal of Science, Engineering, and Advance Technology, IJSEAT, Vol. 5(2017); Zia Ur Rehman et al., "GSM Technology: Architecture Security And Future Challenges"The use of GSM in cellular networks is examined in this article, which also elaborates on topics like GSM security and support subsystem. According to the study, GSM has issues with bandwidth leg
4. B. Vishnupriya et al., "Monitering and Load Detection System"International Journal of Technology and Science Research, Volume 9, 2020This study presents the toll gate weight measurement system constructed with many sensors.Every time the vehicle has to be weighed, it should be brought to the tollgate area.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

III. METHODOLOGY

1. Research and Requirements: Examine current IoT-based platforms, sensors, and systems in-depth. Determine which parts are required, including GPS modules, load sensors, tilt sensors, and cloud services. Obtain project needs from stakeholders and possible consumers.
2. Design: Develop the hardware and software components and create a system architecture. Give details on the microcontrollers, sensors, and communication protocols. Create user interfaces for control and monitoring in real time.
3. Prototyping: To test the system's main features, construct a prototype. This involve building a rudimentary user interface, incorporating sensors, and writing preliminary software. For early testing and validation, use this prototype.
4. Development: Start working on the whole system after the prototype has been verified. Developing the software, constructing the hardware, and integrating all the parts are the tasks of this phase.
5. Testing: Make sure the system operates as intended by thoroughly testing it. Examine alarm systems, GPS tracking, tilt monitoring, and load measurement accuracy. Think about both hypothetical and actual situations. Final Testing: To guarantee the system's dependability, carry out a last round of testing following the completion of any necessary modifications and the incorporation of user feedback.
6. Monitoring and Maintenance: Keep an eye on the functionality of the system and take care of any problems as they appear. Create a maintenance schedule to guarantee the long-term dependability of the system.
7. Project Presentation: Give a thorough explanation of the design, development, and results of your project to your academic institution.

IV. BLOCK DIAGRAM

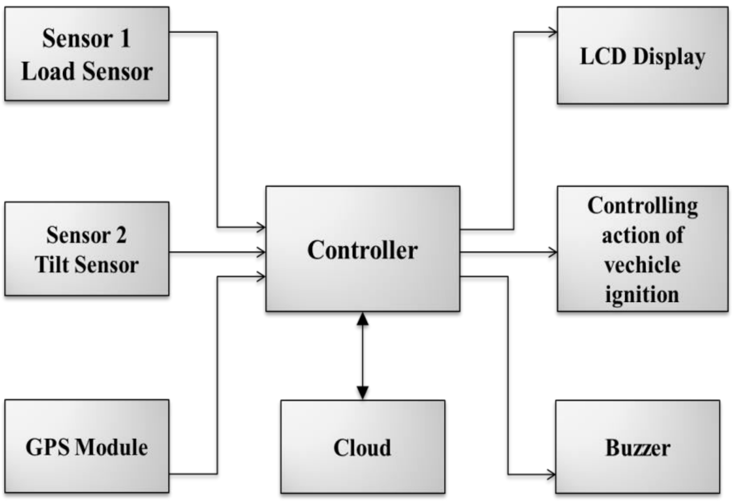


Fig. Block Diagram

V. HARADWARE

1. Load Sensor: This device keeps track of the truck's weight or load. In order to make sure the truck is not overcrowded, this information may be very important.
2. Tilt Sensor: - Determines the truck's inclination or tilt. For stability and safety, especially when travelling, this may be crucial.
3. GPS Module: This module gives the truck precise location data. Real-time monitoring, route optimisation, and tracking are all possible with this data.
4. Controller: - Serves as the system's brain, analysing information from the GPS module, tilt sensors, and load sensors. Based on the data analysis, it also regulates the buzzer, ignition system, and display.
5. Cloud connectivity: This allows data to be sent to a cloud platform. Sending load, tilt, and GPS data for additional examination, archiving, and remote monitoring are a few examples of this.
6. LCD Display: - Provides the truck driver or operator with up-to-date information. GPS coordinates, tilt angle, load status, and any other pertinent data can be included in this.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

7. Ignition System Control: This feature enables the system to regulate the ignition of the car in response to data analysis. For instance, it might activate safety features or turn off the ignition under certain circumstances.
8. Buzzer: - Using information from sensors, emits aural alerts or warnings. This can be helpful in alerting the motorist to potentially dangerous situations.

VI. SOFTWARE

Code of GPS Working

```
#include <ESP8266WiFi.h>
#include <SoftwareSerial.h>
#include <TinyGPS++.h>
#include <FirebaseArduino.h>

SoftwareSerial neo6m(4, 5);
TinyGPSPlus gps;

const char* ssid = "rfid";
const char* password = "12345678";
const char* FIREBASE_HOST = "npksensor-93ff3-default-rtdb.firebaseio.com";
const char* FIREBASE_AUTH = "AIzaSyCyuDrw6AAbCDC6FxViXPu9iWIyemkU5Sk";


void setup() {
  Serial.begin(115200);
  neo6m.begin(9600);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
}

void loop() {
  smartdelay_gps(1000);
  if (gps.location.isValid()) {
    float latitude = gps.location.lat();
    float longitude = gps.location.lng();
    Serial.print("lat:");
    Serial.println(latitude);
    Serial.print("long:");
    Serial.println(longitude);
    Firebase.setFloat("lat", latitude);
    Firebase.setFloat("long", longitude);
    delay(1000);  // Send data every 5 seconds
  } else {
    Serial.println("GPS Not Connected");
  }
}

static void smartdelay_gps(unsigned long ms) {
  unsigned long start = millis();
  do {
    while (neo6m.available())
      gps.encode(neo6m.read());
  } while (millis() - start < ms);
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

```
}
```

Code of Tilt system

```
#include <Wire.h>
#include <MPU6050.h>
#include <Servo.h>
#include <LiquidCrystal_I2C.h>

#include <HX711_ADC.h>
#if defined(ESP8266)|| defined(ESP32) || defined(AVR)
#include <EEPROM.h>
#endif


const int HX711_dout = 4; //mcu > HX711 dout pin
const int HX711_sck = 5; //mcu > HX711 sck pin
Servo sg90;
int servo_pin = 2;
int buzzer_pin = 3; // Define the buzzer pin
MPU6050 sensor;
LiquidCrystal_I2C lcd(0x27, 16, 2);

HX711_ADC LoadCell(HX711_dout, HX711_sck);

const int calVal_eepromAdress = 0;
unsigned long t = 0;

void setup() {
  sg90.attach(servo_pin);

    Wire.begin();
    Serial.begin(9600);
    Serial.println("Initializing the sensor");
    sensor.initialize();
    Serial.println(sensor.testConnection() ? "Successfully Connected" : "Connection failed");
    delay(1000);
    Serial.println("Taking Values from the sensor");
    delay(1000);

    lcd.begin();
    lcd.backlight();

    pinMode(buzzer_pin, OUTPUT);

  Serial.begin(57600);
  delay(10);
  Serial.println();
  Serial.println("Starting...");

  LoadCell.begin();
  float calibrationValue;
  calibrationValue = 284.0;
#if defined(ESP8266)|| defined(ESP32)
#endif

  unsigned long stabilizingtime = 2000;
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

```
  boolean _tare = true;
  LoadCell.start(stabilizingtime, _tare);
  if (LoadCell.getTareTimeoutFlag()) {
    Serial.println("Timeout, check MCU>HX711 wiring and pin designations");
    while (1);
  }
  else {
    LoadCell.setCalFactor(calibrationValue);
    Serial.println("Startup is complete");
  }
}

void loop() {
    int16_t ax, ay, az;
    int16_t gx, gy, gz;

    sensor.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);
    int angle = map(ax, -17000, 17000, 0, 180);
    Serial.println(angle);
    sg90.write(angle);
    delay(200);

    static boolean newDataReady = 0;
    const int serialPrintInterval = 0;

    if (LoadCell.update()) newDataReady = true;

    if (newDataReady) {
        if (millis() > t + serialPrintInterval) {
            float weight = LoadCell.getData();
            Serial.print("Load_cell output val: ");
            Serial.println(weight);

            if (weight > 400) {
                digitalWrite(buzzer_pin, HIGH); // Turn on the buzzer
                lcd.clear(); // Clear the LCD
              lcd.setCursor(0, 0); // Set cursor to first row
              lcd.print("ALERT: Weight > 400"); // Print alert message on LCD
              delay(2000); // Delay for 2 seconds
            } else {
                digitalWrite(buzzer_pin, LOW); // Turn off the buzzer
            }

            lcd.clear(); // clear the LCD
            lcd.setCursor(0, 0); // set cursor to first row
            lcd.print("Angle: "); // print out to LCD
            lcd.print(angle); // print out the angle value to the first row
            lcd.setCursor(0, 1); // set cursor to second row
            lcd.print("Weight: "); // print out to LCD
            lcd.print(weight);

            newDataReady = false;
            t = millis();
        }
    }

    if (Serial.available() > 0) {
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

```
    char inByte = Serial.read();
    if (inByte == 't') LoadCell.tareNoDelay();
  }

  if (LoadCell.getTareStatus() == true) {
    Serial.println("Tare complete");
  }

  // Buzzer control logic
  if ((angle >= 50 && angle <= 80) || (angle >= 110 && angle <= 125)) {
    digitalWrite(buzzer_pin, HIGH); // Turn on the buzzer
  } else {
    digitalWrite(buzzer_pin, LOW); // Turn off the buzzer
  }

  delay(500);
}
```

VII. RESULTS

Decreased Cargo Spills and Damage: • The tilt mechanism and truck bed sensors could keep an eye on the tilt angles and cargo weight distribution.
• Real-time alerts have the potential to minimize spills and product damage by alerting drivers to possible instability.
• The project's outcomes could indicate a sharp decline in insurance claims and accidents involving cargo.yell
Increased Stability and Safety: • The system could keep an eye on the weather and modify tilt angles to provide the best possible stability on various types of terrain.yell
• Information on proper loading methods and center of gravity management could improve driver education.
• The project's outcomes might point to fewer truck rollovers and more driver security.
Efficiency and productivity gains: • The system has the potential to optimize loading and unloading processes by taking into account the weight and distribution of the cargo.
• Potential problems could be found via real-time monitoring before they cause delivery delays.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304073 |

• Shorter loading times, quicker delivery turnaround times, and better fleet management could be the outcomes of the project.

Data-Driven Maintenance: • The hydraulic and tilt mechanism stresses might be tracked by the system.

• By using sensor data, predictive maintenance alarms might be set off, averting expensive repairs and malfunctions.

• The project's outcomes might show longer equipment lifespans and shorter maintenance intervals.

REFERENCES

1."An IoT-Based Vehicle Monitoring and Driver Assistance System for Enhancing Road Safety," by C. Y. Li, Y. C. Hsu, and Y. P. Hsieh, IEEE Transactions on Industrial Informatics, vol. 11, no. 3, pp. 7006-7015, June 2015.

2. "Internet of Things (IoT) Based Truck Fleet Management: Towards Energy Efficiency," by Y. Kim and M. R. J. Shah, presented at the IEEE International Conference on Automation Science and Engineering (CASE), Gothenburg, Sweden, 2015.

3. "Internet of Things for an Intelligent Transport System: An Overview," by J. R. Sánchez-Torres, E. A. Portilla-Figueras, and M. Guinaldo, appeared in IEEE Transactions on Intelligent Transportation Systems, vol. 16, no. 4, August 2015, pp. 1709–1717.

4. "IoT-Based Vehicle Accident Detection and Notification System," by K. P. Subramanian, in 2018 IEEE International Conference on System, Computation, 2018; Pondicherry, India: Computation, Automation and Networking (ICSCAN).

5. "IoT Based Intelligent Vehicle Monitoring and Tracking System," by N. Sarika and A. Annappa, presented at the IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI), August 2017 in Chennai, India.

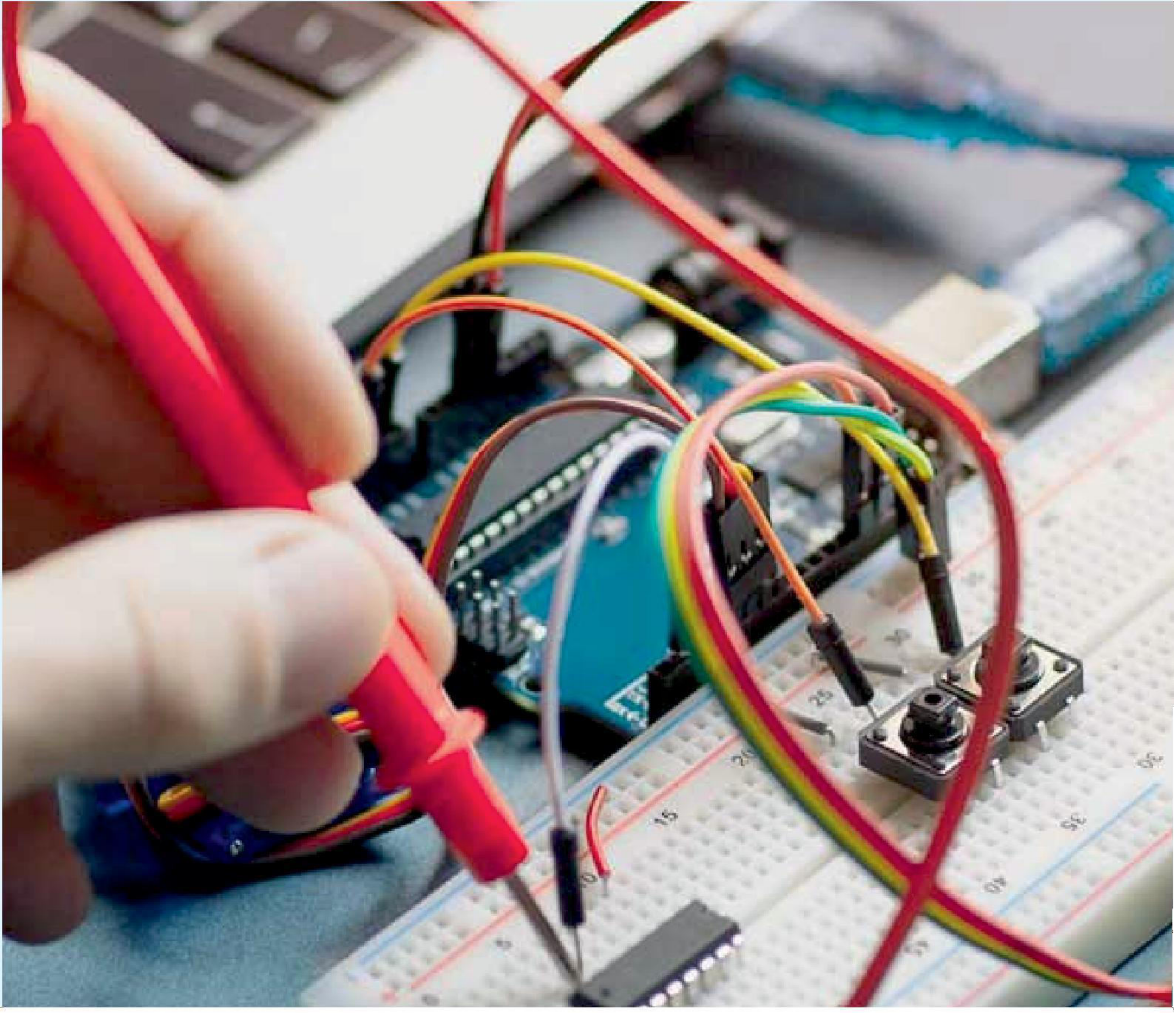
6. "IoT-Based Vehicle Tracking and Driver Monitoring System for Road Safety," J. Bhardwaj and B. Anand, IEEE 8th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), New York, NY, USA, 2017.

7. "Internet of Things (IoT) Connectivity and Security Issues: A Comprehensive Study," Alan Alsamhi, Z. F. Hanandeh, and N. S. M. El-Tawil, IEEE Access, vol. 7, pp. 7606-7619, 2018.

8. "Digital Twin in Industry: State-of-the-Art," F. Tao, J. Zhang, L. Liu, and Y. Nee, IEEE Transactions on Industrial Informatics, vol. 15, no. 4, pp. 2405-2414, April 2019.

9. "IoT-Based Monitoring and Controlling Systems: A Systematic Review," P. Barrachina-Muñoz, J. C. Díaz-Molina, and G. Rodriguez-Navas, Sensors, vol. 19, no. 3, 2019.

10. M. Z. A. A. Aziz, A. Shahbaz, and S. Sarfraz, "IoT-based Safety and Health Monitoring Devices for the Industry," in IEEE 9th International Conference on Consumer Electronics (ICCE-Berlin), Berlin, Germany, 2019.



International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering