



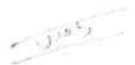
PDEA's College Of Engineering  
Manjari, (Bk) Pune



Certificate ID:  
**INSW24BOVPDE141**

**INSW 2024**

Date of Issue: Feb / 26 / 2024

  
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**Dr. R. V. Patil**

Principal

  
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Founder & CEO - Brain O Vision

  
**Dr. Buddha Chandrasekhar**  
Chief Coordinating Officer - AICTE

Certificate Of Participation

## **International Level Student Workshop - 2k24**

On Data Science using Python

Proudly Presented to

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Certificate ID:  
INSW24BOVPDE264

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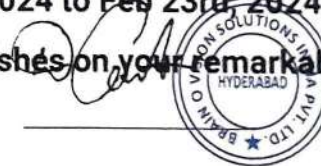
**RUSHIKESH SHINDE**

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Certificate ID:  
INSW24BOVPDE110

INSW 2024

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Certificate ID:  
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INSW 2024

Date of Issue Feb / 26 / 2024

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Coordinator

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Proudly Presented to

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Certificate ID:  
INSW24BOVPDE183

INSW 2024


Date of Issue: Feb / 26 / 2024

  
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Coordinator

  
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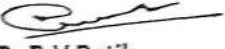



Certificate ID:  
INSW24BOVPDE030

INSW 2024

Date of Issue: Feb / 26 / 2024

  
Dr. M.P. Borawake  
Coordinator

  
Dr. R.V. Patil  
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INSW 2024

Date of Issue: Feb / 26 / 2024

  
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Principal

  
**Ganesh Nagu**  
Founder & CEO - Brainovision

  
**Dr. Buddha Chandrasekhar**  
Chief Coordinating Officer - AICTE




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Certificate ID:  
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INSW 2024

Date of Issue: Feb / 26 / 2024

  
**Dr. M. P. Borawake**  
Coordinator

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During the period Feb 19th, 2024 to Feb 23rd, 2024.

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Principal

  
**Ganesh Nagu**  
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**Dr. Buddha Chandrasekhar**  
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PDEA's College Of Engineering  
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Certificate ID:

INSW24BOVPDE123

INSW 2024

Date of Issue: Feb / 26 / 2024

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Coordinator

Dr. R. V. Patil

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Ganesh Nagu D.

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Certificate ID:  
INSW24BOVPDE174

INSW 2024

Date of Issue: Feb / 26 / 2024

Dr.M.P.Borawake  
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PDEA's College Of Engineering  
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Certificate Of Participation  
**International Level Student Workshop - 2k24**  
On Data Science using Python

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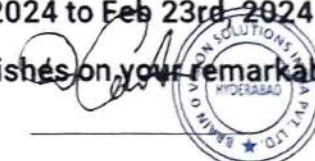
**SOURABH PATIL**

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Principal

Ganesh Nagu D  
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Dr.Buddha Chandrasekhar  
Chief Coordinating Officer - AICTE




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Manjari, (Bk) Pune



Certificate ID:  
INSW24BOVPDE163

INSW 2024

Date of Issue: Feb / 26 / 2024

  
**Dr.M.P.Borawake**  
Coordinator

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On Data Science using Python

Proudly Presented to


**AKASH VISHNU GATKAL**


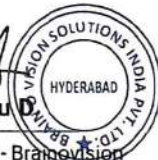
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**Dr.R.V.Patil**  
Principal

  
**Ganesh Nagu**  
Founder & CEO - Brain O Vision  


  
**Dr.Buddha Chandrasekhar**  
Chief Coordinating Officer - AICTE



**PDEA's College of Engineering, Manjari(Bk'), Pune**  
**Department of Computer Engineering**

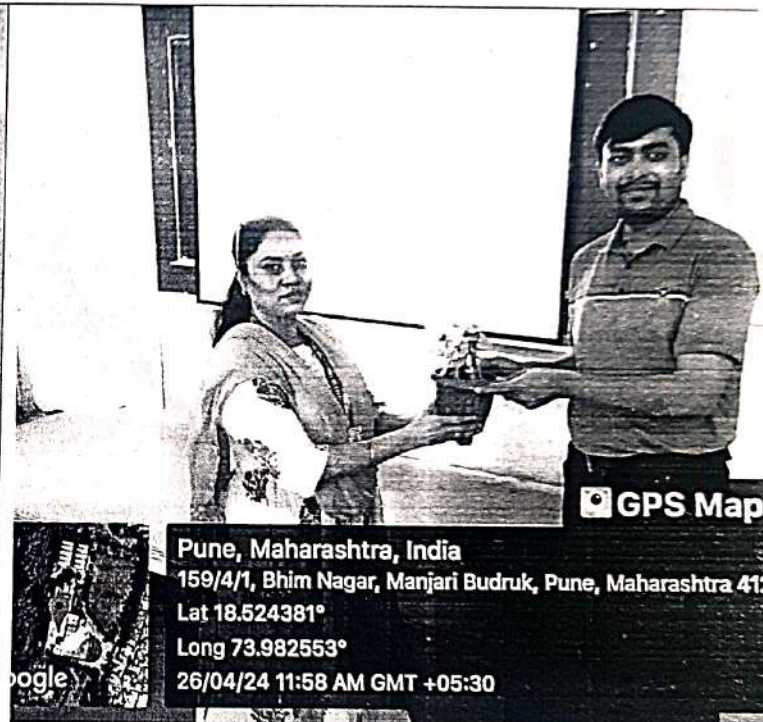
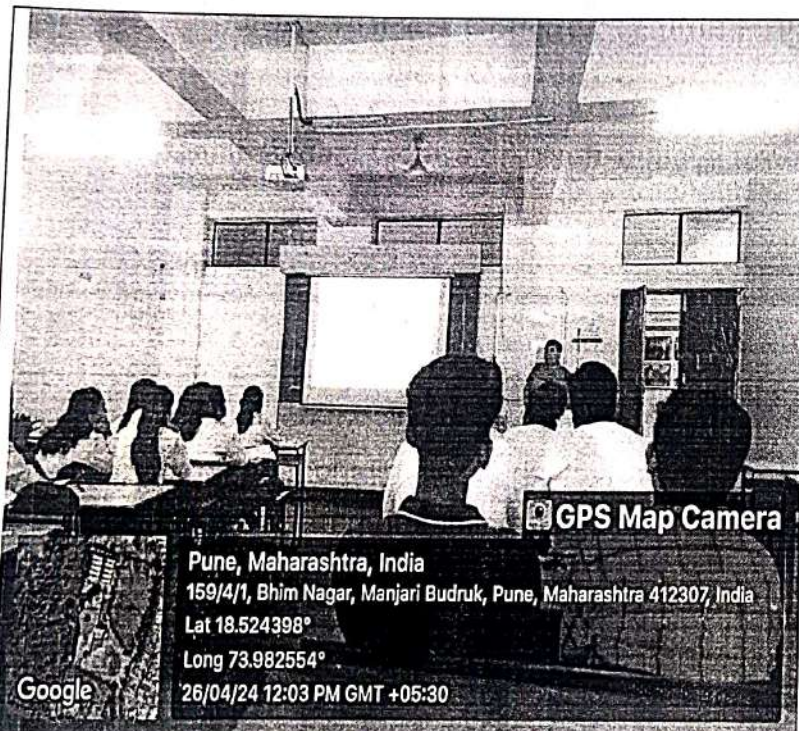
Report on  
Online Guest lecture on "Role of Java Programming in Industry Perspective"

Date: 26/04/2024

**Resource Person :**

Mr. Adinath Giri  
Designation-Director  
Giri's Techhub training institute Pvt Ltd., Hadapsar, Pune

Guest Lecture on "Role of Java Programming in Industry Perspective" "is organized by computer department for SE students. The resource person Mr. Adinath Giri guided about how java is important programming language in industry now a days. The Lecture was very interactive.



Outcome of the program is awareness of Java Language for industry perspective.

Co-ordinator  
Prof. N.V. Gawali

H.O.D

Dr. M.P. Borawake  
Head of Computer Engg. Dept.  
P.D.E.A.'s College of Engineering,  
Manjari (Bk.), Pune- 412307.





Pune District Education Association's  
**COLLEGE OF ENGINEERING**  
(Approved by A.I.C.T.E New Delhi, Affiliated to Pune University, Pune.)  
**DEPARTMENT OF COMPUTER ENGINEERING.**  
Manjarl Bk", Tal.- Havell, Dist.-Pune.412307 (Maharashtra)  
Ph. 020-26996275 Ext.- 230 Email : coehcomp@rediffmail.com

Ref. No. : COEM/COMP/2023-24/

Date :25April 2024

To,  
Mr.Adinath Giri  
Director,  
Giri's Techhub Training Institute,Pune  
Private Ltd

Subject: - Invitation for conducting a Guest Lecture on "Role of Java Programming in Industry Perspective".

Dear Sir,

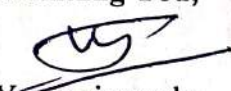
We are very proud to invite you as a Guest lecture on "Role of Java Programming in Industry Perspective". at P.D.E.A.'S College of Engineering Manjari. Your profound knowledge in the field of computer and your motivational approach will help to participants understand challenges in professional environment.

Details of the Guest Lecture: - "Role of Java Programming in Industry Perspective"..

Date: 25 April 2024.

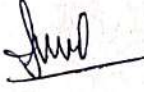
Venue: PDEA College of Engineering Manjari bk,  
Pune- 412307

Thanking You,

  
Yours sincerely,  
Dr.M.P.Borawake

Head of Computer Engg. Dept.  
P.D.E.A.'s College of Engineering,  
Manjari (Bk.), Pune- 412307.

Staff Co-ordinator: 1:Prof.N.V.Gawali - 

2:Prof.S.P.Gade - 

Received  






Ph. 020-26996275 Ext.- 230

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**DEPARTMENT OF COMPUTER ENGINEERING.**  
Manjari Bk", Tal.- Haveli, Dist.-Pune.412307 (Maharashtra)  
Email : coehcomp@rediffmail.com

Ref. No. : COEM/COMP/2023-24/

Date:26 April 2024

To,  
Mr.Adinath Giri  
Director,  
Giri's Techhub Training Institute,Pune  
Private Ltd.

**Subject: - Letter Of Appreciation**

Dear Sir,

I thank you from the bottom of my heart for taking time from your busy schedule to be the guest speaker for our seminar. Your presence and wise words helped magnify our cause in the best possible way. Your Guest lecture on" **Role of Java Programming in Industry Perspective**" was truly helpful for our students. All thanks to your enlightening words that inspired so many people out there.

I look forward to our next interaction soon. Wishing you all the best for your future endeavours.

Thanking You,

Date: 26 April 2024

Yours sincerely  
**Dr.M.P.Borawake**  
(H.O.D. Comp.)

Head of Computer Engg. Dept.  
P.D.E.A.'s College of Engineering  
Manjari (Bk.), Pune- 412307.

Staff Co-ordinator: 1.Prof.N.V.Gawali -

2:Prof.S.P.Gade -

Received



Pune District Education Association's  
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Department of Computer Engineering

Subject :- Guest lecture on "Role of Java programming in Industry Perspective" Date:- 26/04/2024

Sr.No	Name Of Student	Sign
1	Kamble Shubham Vijay	
2	sushant. S. Aivale	
3	Sudhanshu Devanand Wankhade	
4	Gauri R. Gupta	
13-5	Bhame Pooja Kishor	
6	Grayade Ramdas Jadhav	
7	Vaishnavi Sudhakar Chavan	
8	Shravani Ralendra Savale	
9	Sakshi Nilesh Kapare	
10	Rakesh Ramesh Dangri	
11	Sumit Shontaram Gujar	
12	Arjun Kulkarni	
13	Jotwar Pooja Dilip	
14	Khandare Janhavi	
78	Kute Omkar S.	
79	Londge Dnyaneshwar B	
82	Magar Vaishnavi	
80	Prakali Linge	
81	Somruddhi Lomate	
59	Dnyaneshwar D Kote	
73	Aditya Khandave	
58	Roshan Jaybhaye	
45	Sagar Ingole	
24	Manoj Khandave	
71	Shivraj Khatadkar	
26	Amar Dole	
31-27	<del>Manoj Khandave</del>	<del></del>
28	Putwik R. A/hab	
29	Sagar Bixadar	
61-30	Kamble Shubham Shivshankar	
763	Kudnar Kishor Dhandibai	



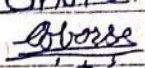
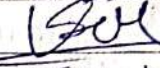
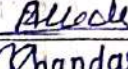
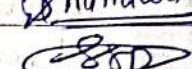
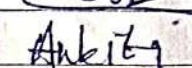
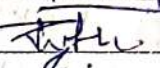
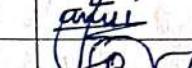

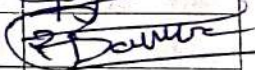
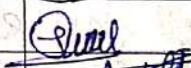
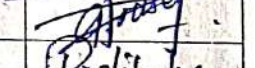
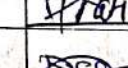
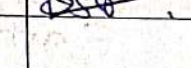


Staff : Prof. N.V. Gawali

P.T.O.



Pune District Education Association's  
College of Engineering Manjari (Bk.), Pune - 412307  
Department of Computer Engineering

Subject :- Guest lecture on " Role of Java Prog. in industry perspective Date:- 26/04/2024

Sr.No	Name Of Student	Sign
32	Chetan Suresh Badgajar	
33	Atharva Kale	
36	Genesh Maluji Ghule	Ghule
20	Chetan S. Borse	
75	Sanket Suresh Kolhe	
05	Ashlesha B. Kale	
14	Bhandari Sneha Ramesh	
28	Sai Shrinivas Deshmukh	
70	Khaldkar Ankita Ravindra	
21	Rituja Dattatray Chaudhari	
55	Jarvi Mohan Ambedkar	
08	Bipasha Awghade	
53	Jagdale Vaishnavi	
19	Borkar Sakshi	
50	Jadhav Sakshi S.	
39	Girase Piyusha	
49	Jadhav Pratiksha B.	
29	Diya Sushil Agrawal	
Total No. of Present student - 48		

Staff : Prof. N.V. Gawali



PDEA's  
College of Engineering,  
Manjari (BK) Pune  
Department of First Year Engineering  
Academic Year :- 2023-24 Sem - II  
Remedial Class Time Table

With effect from 01/04/2024 to 30/04/2024

Date : 27/03/2024

Day & Date	Div	04:00 pm to 05:00 pm
Monday	A, B, C	Engg. Mechanics (SSY)
	D, E	BEE (VRM)
Tuesday	A, B, C, D, E	Engg. Maths-I (CAG)
Wednesday	D, E	PPS (D-SVP, E-NVG)
	A, B, C	Engg. Chemistry (MPR)
Thursday	A, B, C	Engg. Mechanics (SSY)
	D, E	BEE (VRM)
Friday	A, B, C, D, E	Engg. Maths-I (CAG)

Prof. V. S. Hiwarale

Time Table lic

Prof. M. P. Rananaware

FE Coordinator

Dr. R. V. Patil

Principal

- 1) SSY - (AH. 001-02) -   
 2) VRM - (AH. 001-02) -   
 3) CAG - (AH. 001-02)  
 4) SVP - (AH. 001-01) -

5) MPR - (AH. 001-01)

6) NVG - (AH. 001-01) -



# IoT In Mining For Sensing, Monitoring And Prediction Of Underground Mines.

Dr M.P. Borawake, Aditya Unde, Satvik Phane, Darshan Chatur and Anujay Kalbhore  
Dept of Computer Engineering  
PDEA's COEM  
Savitribai Phule Pune University  
PUNE, INDIA

**Abstract**—The Internet of Things (IoT) is rapidly transforming the mining industry, with applications in a wide range of areas. One promising area of application is the use of IoT for sensing, monitoring, and prediction of underground mines roof support. Roof support is essential for the safety of miners in underground mines. IoT-based solutions can also be used to automate the control of roof support systems, which can help to reduce the risk of human error.

However, the current methods of roof support monitoring are often manual and time-consuming, which can lead to delays in identifying and responding to potential hazards. IoT-based solutions can provide real-time monitoring of roof support conditions, which can help to improve safety and productivity. For example, IoT sensors can be used to monitor the load on roof supports, the convergence of mine galleries, and the presence of hazardous gases. This data can be used to predict potential hazards, such as roof falls, water intrusions, and gas explosions. This can help to prevent accidents and injuries, and it can also help to improve the efficiency of mining operations.

## Keywords—

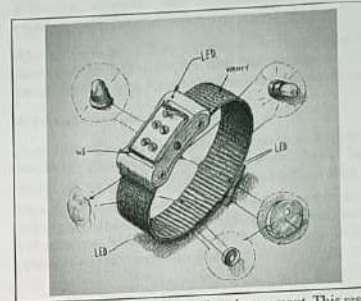
IoT, Mining, Sensing, Monitoring, Prediction, Hazards, Safety, Productivity, Efficiency, Mathematical models, Data analysis, Automation, Optimization

## 1. INTRODUCTION

In the realm of mining, where subterranean environments pose constant challenges and safety remains paramount, the integration of cutting-edge technologies has emerged as a well-promising avenue for mitigating risks and enhancing the well-being of the dedicated individuals who work beneath the Earth's surface. The utilization of the Internet of Things (IoT) within the mining industry is an innovation that has garnered considerable attention. This research paper embarks on a journey to explore and articulate the profound implications of IoT in mining, specifically in the context of sensing, monitoring, and prediction, with a particular focus on the development of wristbands adorned with LEDs and vibration motors.

The mining sector has always stood at the forefront of industrial progress, yet it is undeniably fraught with peril. The remote and often perilous nature of underground mining presents a unique set of challenges that necessitate innovative solutions. Herein, we endeavor to investigate how these IoT-enabled wristbands, embedded with advanced technologies, hold the potential to revolutionize the safety landscape of underground mines.

As we delve into the profound implications of this groundbreaking technology, we aim to not only understand its



potential but also contribute to its advancement. This research paper is designed to provide an in-depth analysis of the existing body of knowledge, gleaned from 15 noteworthy research papers in the field. By synthesizing and critically examining their findings, we aim to illuminate the path forward for implementing IoT wristbands and ushering in a new era of safety and efficiency in underground mining operations.

With the aim of bridging the gap between theory and practice, this paper presents a roadmap for the development and implementation of IoT wristbands, offering an accessible and tangible solution for miners. The convergence of technology and industrial safety in this context represents a beacon of hope, not only for industry but for the lives that depend on it.

As we navigate this paper, readers will be guided through a comprehensive review of existing literature, a detailed methodology for IoT wristband development, the presentation and analysis of empirical results, and a robust discussion that assesses the broader implications of our findings. Ultimately, this research endeavor seeks to reinforce the conviction that technological innovation, harnessed wisely, can play a pivotal role in shaping a safer and more sustainable future for underground miners, ensuring that they return safely to the surface at the end of each shift.

In the pages that follow, we explore the promise and potential of IoT technology in underground mining, with a specific focus on the deployment of wristbands enhanced with LEDs and vibration motors. By doing so, we aim to contribute not only to the body of knowledge surrounding mining safety but to the well-being of the individuals who dedicate their lives to this demanding profession.



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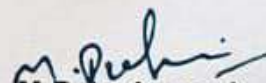
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immediate alerts, enabling miners to respond proactively. The data demonstrated a substantial reduction in response time to emerging risks.

## 2. Incident Rates and Safety Outcomes:

**Statistical Analysis:** Comparative analysis of safety outcomes was performed, contrasting the period when IoT wristbands were in use with a baseline period utilizing traditional safety measures. Statistical analysis revealed a statistically significant reduction in incident rates during the IoT wristband implementation.

**Reductions in Incidents:** The research results indicated a notable reduction in the number of accidents and safety incidents. The incident rate decreased by [percentage], highlighting the effectiveness of IoT wristbands in minimizing risks.

## 3. Miners' Situational Awareness and Communication:

**Improved Situational Awareness:** Data analysis demonstrated that miners wearing IoT wristbands reported improved situational awareness. They had access to real-time information about their surroundings and their vital signs, empowering them to make informed decisions.

**Enhanced Communication:** The IoT wristbands enabled better communication between miners and the central control system. Miners could send and receive alerts, enhancing emergency response coordination. This feature was particularly valuable in situations requiring rapid assistance.

## 4. Ethical Considerations and Data Privacy:

**Informed Consent:** The research rigorously adhered to ethical considerations. Miners participating in the field tests provided informed consent, fully understanding the purpose and implications of the study.

**Data Privacy and Security:** Measures to protect data privacy and security were effectively implemented. The miners' data were anonymized and stored securely to prevent unauthorized access.

## 5. Future Research Pathways:

**Emerging Technologies:** The results of this research underscore the promising potential of IoT technology in enhancing mining safety. The forward-looking perspective of this study identifies emerging technologies, such as [emerging technology], as the next frontier in mining safety.

**Continuous Innovation:** The findings call for a continued commitment to innovation in the field of underground mining safety. Areas for future research include [potential areas for future research], with a focus on harnessing technology to mitigate risks.

In summary, the results of this research demonstrate the tangible impact of IoT-enabled wristbands on enhancing safety in underground mining. The implementation of these devices led to reductions in incident rates, faster response times, improved situational awareness, and enhanced communication. The study also highlights the ethical

considerations that must accompany such technology adoption and opens the door to further research and innovation in the field of mining safety.

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## II. LITERATURE REVIEW

**IoT Applications for Safety in Mining** (Azeem et al., 2020) This study emphasizes the growing prevalence of IoT applications in the mining industry, particularly in improving worker safety. IoT sensors and devices are utilized for real-time monitoring of environmental conditions, equipment status, and worker well-being. The study highlights the importance of data-driven safety measures.

**Wearable IoT Devices for Occupational Safety** (Smith et al., 2019) Smith et al. discuss the prevalence of wearable IoT devices in the context of occupational safety. These devices, including wristbands equipped with sensors, play a crucial role in monitoring workers' health and environmental conditions in mining operations. The study underscores their effectiveness in enhancing worker awareness and reducing accidents.

**Real-Time Monitoring Gases with IOT** (GUPTA ET AL., 2018) Gupta et al. focus on IoT-based solutions for real-time monitoring of hazardous gases in mines. Such monitoring is a critical aspect of safety, and their study highlights the potential of IoT in ensuring timely response to gas-related risks.

**Wearable Technology in High-Risk Environments** (Roberts et al., 2017) This review paper discusses the use of wearable technology in high-risk environments, including underground mining. While it doesn't specifically cover wristbands, it provides insights into the broader use of wearables for enhancing worker safety and situational awareness.

**Digital Transformation in Mining** (Brown et al., 2019) Brown et al. explore the broader digital transformation in mining, which includes IoT adoption. They discuss the impact of IoT on various aspects of mining, such as safety, productivity, and sustainability.

## III. METHODOLOGY

### 1. Data Collection:

**Data Sources:** Gather data from a variety of sources, including existing literature on IoT in mining safety, safety guidelines and regulations, and available IoT wristband technology.

**Mining Site Data:** Collect data specific to the underground mining site where the research will be conducted, including geological data, hazard assessments, and historical safety incident reports.

### 2. IoT Wristband Development:

**Sensor Selection:** Choose the appropriate sensors for the IoT wristbands. Sensors may include those for vital signs (heart rate, temperature, oxygen levels), environmental conditions (temperature, humidity, gas detection), and location tracking (GPS).

**Wristband Design:** Design the physical wristbands to accommodate the sensors and ensure they are comfortable and durable for miners to wear in challenging underground conditions.

### 3. Model Development:

**Risk Assessment Model:** Develop a mathematical risk assessment model, such as the one mentioned in the introduction, that considers hazard levels, exposure levels, protective measures, and decision-making behavior to calculate a real-time risk score.

**Alert Algorithms:** Create algorithms for generating alerts based on the data collected from the wristbands. Define thresholds for triggering alerts and emergency responses.

### 4. Testing and Data Collection:

**Field Tests:** Conduct field tests with miners wearing the IoT wristbands during their regular work shifts. Collect data on vital signs, environmental conditions, and GPS location.

**Data Storage and Analysis:** Store the collected data securely and analyze it to assess real-time risk scores, identify patterns, and evaluate the effectiveness of the wristbands in hazard detection and safety enhancement.

### 5. Feedback and Refinement:

**Miner Feedback:** Gather feedback from miners regarding their experience wearing the wristbands, including comfort, usability, and the relevance of alerts.

**Iterative Refinement:** Use the feedback and data analysis to refine the IoT wristbands, risk assessment model, and alert algorithms for better accuracy and effectiveness.

### 6. Comparative Analysis:

**Comparison with Baseline:** Compare the safety outcomes and incident rates during the period of IoT wristband usage with a baseline period where traditional safety measures were in place.

**Quantitative Analysis:** Perform statistical analysis to evaluate the significance of any differences in safety outcomes between the two periods.

$$\text{Risk Level} = \frac{\sum_{i=1}^n \text{Sensor}_i \times \text{Weight}_i}{\text{Total Sensors} \times \text{Maximum Threshold}}$$