SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

VADAPALANI CAMPUS, CHENNAI - 600026

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

PROJECT TITLE : IOT BASED SMART INDUSTRY MONITORING AND ALERTING SYSTEM

by

TEAM MEMBERS

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ABSTRACT

In this demonstration proposal,

- A Prototype of IoT Based Smart Industry Monitoring and Alerting System to monitor, locate and successively alert gas leaks of a complex factory environment.
- Unlike Traditional Systems, we've used IoT technology to make a Smart Industry Monitoring and Alerting System and to perform data analytics on sensor readings using cloud service successively.
- This will detect any leakage of harmful gases, supporting and displaying the level and the location of the leakage.
- The aim of this project is to develop such a device that can automatically detect and alert the corresponding officials thus, stopping gas leakages in those permeable areas.
- Throughout the demonstration, the technological advantages of our prototype – "IoT Based Smart Industry Monitoring and Alerting System" are explored.

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EXISTING SYSTEM

IOT Based Industry Quality Monitoring System

Architecture Description

- Sensor monitoring pollution level and Monitoring the gas leakage level which updates to the given server.
- Monitors the gas leakage level using Raspberry Pi. The real time data obtained from the different sensors which sense's the different concentration of gases.

Methodology

- The development of pollution monitoring system with deployment of intelligent sensors is being carried out.
- Monitoring the gas leakage level is achieved.
- Analysis of the data is simplified thereby enabling ease of monitoring.
- Alerts can be triggered in case of drastic deterioration of air quality using Raspberry Pi based gas detection system - detect the presence of toxic gases respectively

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RESULT OF THE SYSTEM

- Able to monitor and identify the changes.
- This work demonstrates a gas leak detection system with real time location system based on WSNs.
- This IOT based Smart Industry Monitoring system gives real-time monitoring.
- Temperature, humidity, level of chemicals, also detects the Leakage of gas,

CHALLENGES TO BE ADDRESSED

- ✓ Need a internet connections to access from anywhere in the world without cannot access | Wifi has limited range Speed of the most wireless network
- ✓ Range affected by varies medium and slower than the cable.
- ✓ Comparisons of particulate measurements are also problematic to measure
- ✓ Range of reference-equivalent methods available and the limitations, in many ways, of the reference method itself.

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PROPOSED PROJECT SUMMARY

- A prototype of **IoT Based Smart Industry Monitoring and Alerting System** to monitor, locate and successively alert gas leaks of a complex factory thus, controlling the pollution.
- The proposed model - has two server sections one is factory server and another one is TNPCB server. Sensors are used to monitor the pollution level and update to both factory and also TNPCB Server respectively.
- This aims at analyzing the type of industry, studying the nature of processes involved and identifying the probability of gas leakage. In addition to gas leakage, fuel leakage can also be addressed.
- Potential points can be identified and corresponding sensors can be installed which can monitor and record the data.
- The obtained data is being sent to Cloud which facilitates monitoring by authorized personnel in TNPCB. Initiating preventive actions by alarms in case of any abnormalities found in the received data. Thus, by regulating their actions successively.

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SOFTWARE AND HARDWARE SPECIFICATION

Software Requirements

- Language Programmed: C++, Java
- Compiler Used : Arduino Uno IDE
- Other Softwares Used : Android Studio, VS Code

Hardware Requirements

- NODEMCU
- LCD 16*2
- Arduino UNO
- GAS Sensor
- Temperature Sensor
- Humidity sensor
- Relay
- Buzzer
- Power unit

SYSTEM DESIGN

ARCHITECTURE DIAGRAM

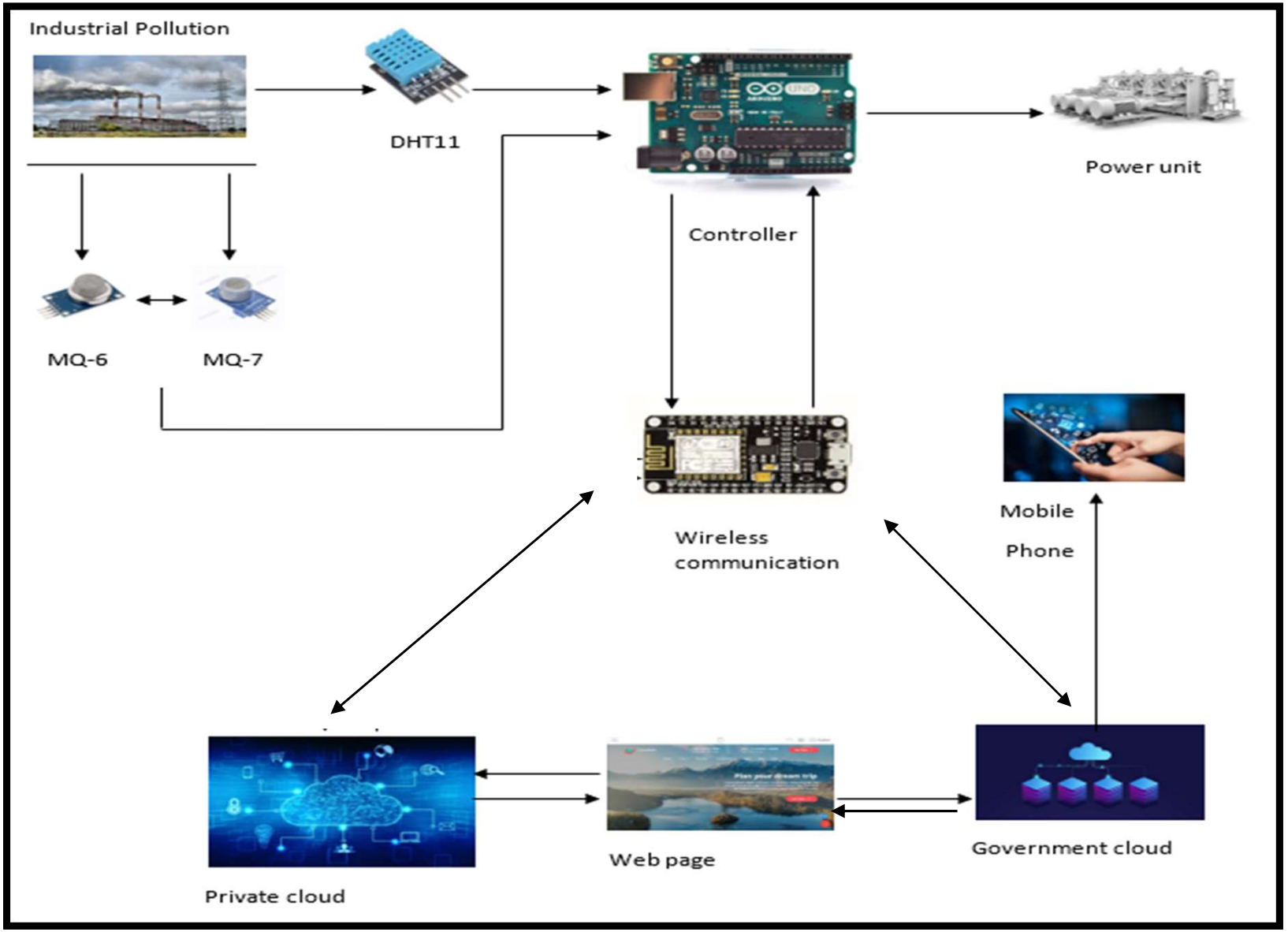

Fig. 1 – Model Architecture Diagram

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USE CASE DIAGRAM

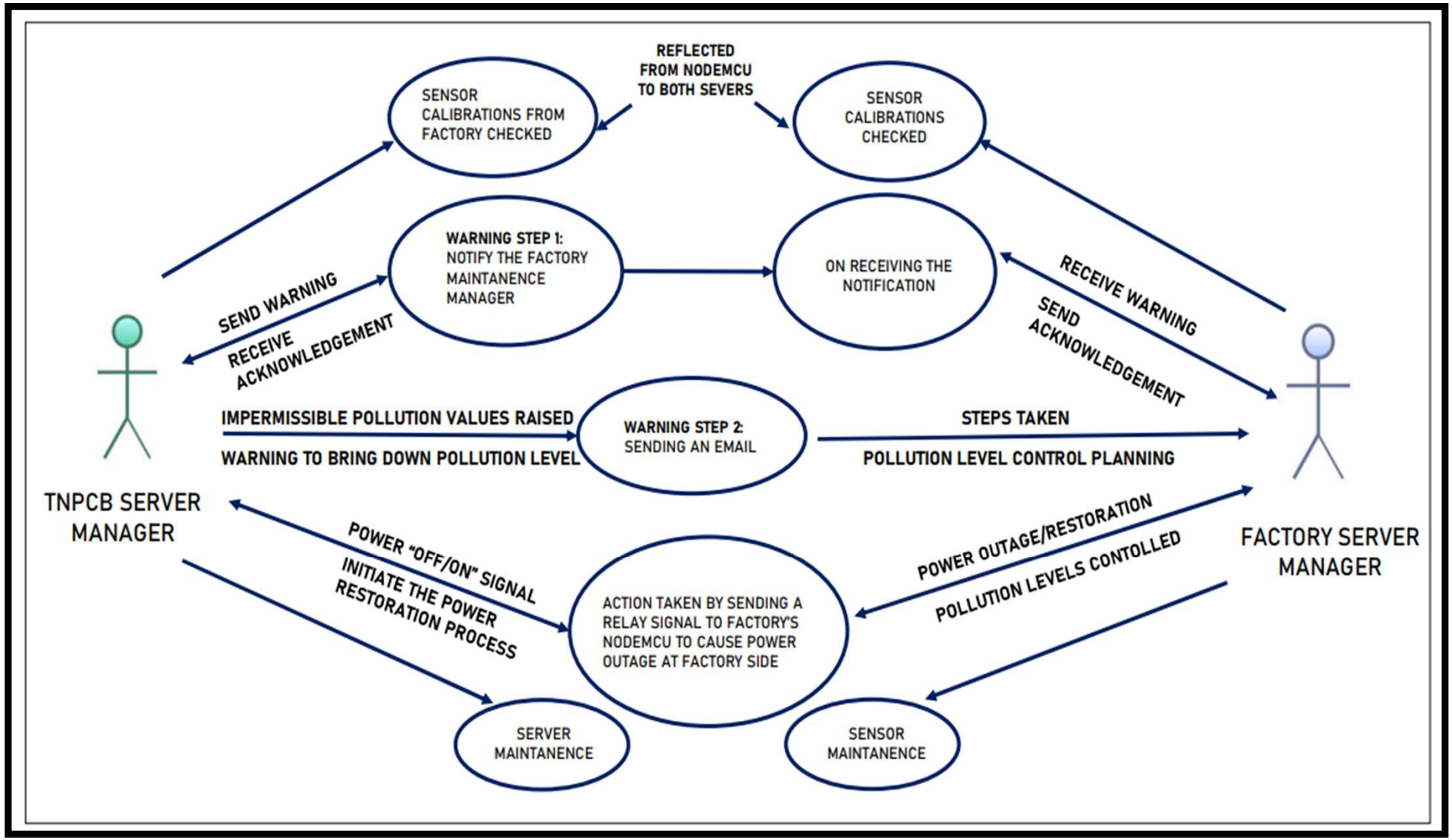

Fig. 2 – UML Diagram

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METHODOLOGY USED

- Above the block diagram contains NODEMCU processor, Arduino UNO, gas sensor, temperature sensor, humidity sensor, power unit.
- Sensors are connected to GPIO Pin of Arduino UNO. NODEMCU connected to UART Port of Arduino UNO, which collects the sensor values from Arduino UNO and sends them to the cloud.
- The Sensor Values are updated to two server rooms (Factory Server and TNPCB Government Server) and are constantly stored in cloud database using Firebase.
- If Processor receives abnormal values, a notification will be released in form of buzzer. TNPCB will send the warning message to respective factory official in their respective application developed for mobile
- If the company does not abide pollution controlling process, the relay achieves the outage of power supply from the TNPCB's action

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FLOW DIAGRAM

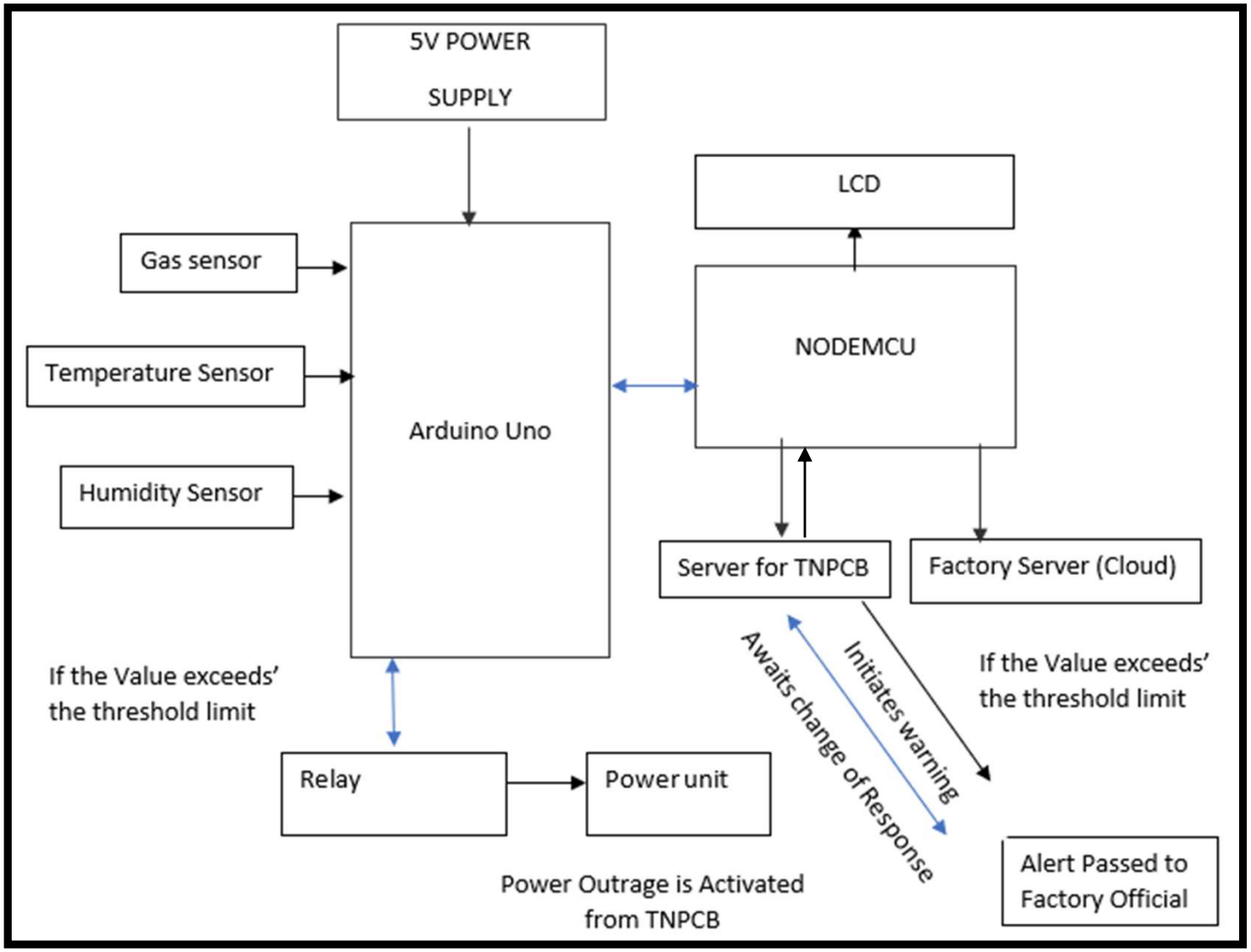

Fig. 3 – Process Flow Diagram

TECHNICAL MODULES INVOLVED IN THE PROJECT

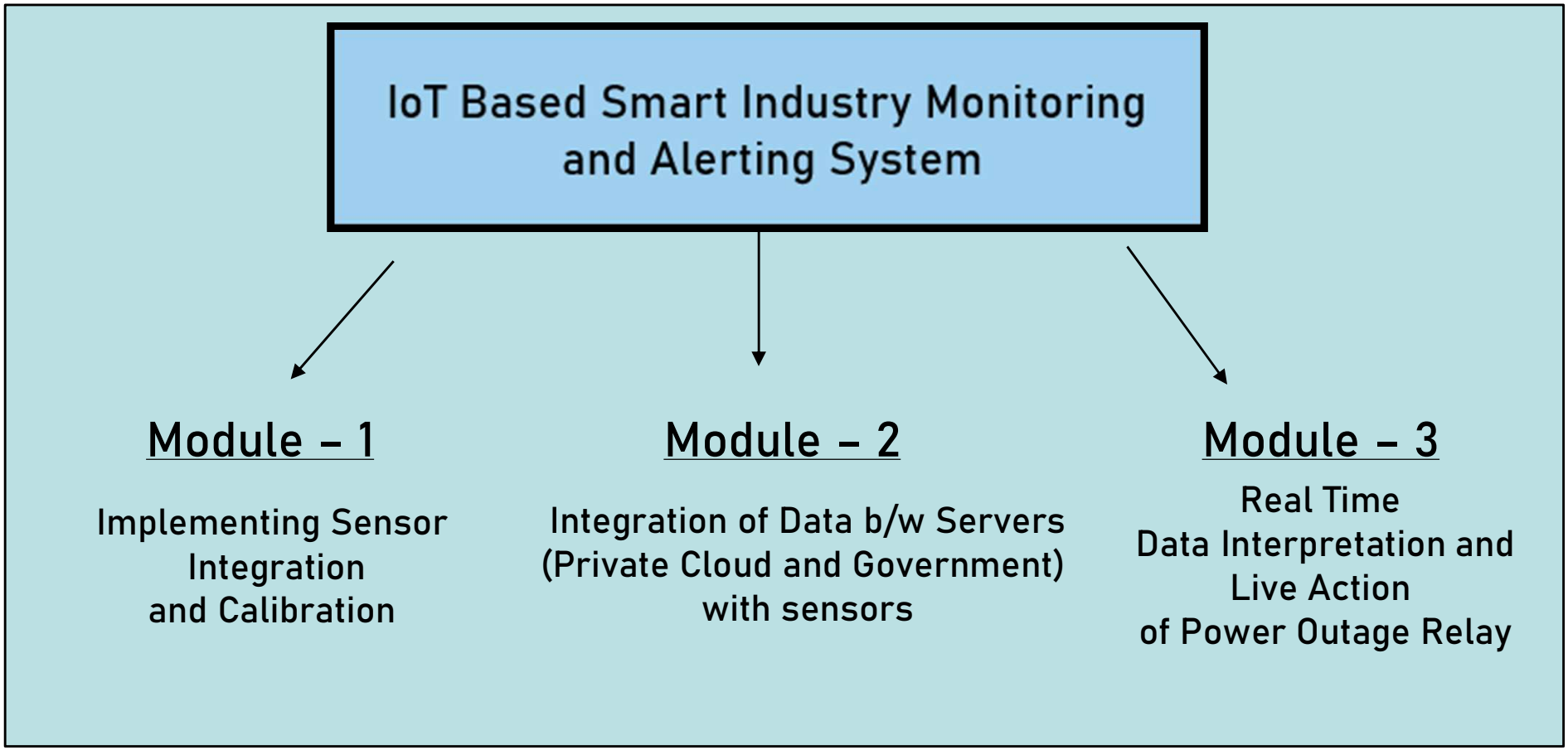

Fig. 4 – Modules involved

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MODULE – 1

Implementing Sensor Integration and Calibration

Technical Description

- In this system, NODEMCU acts as the internet connector and information accessing for the air quality and the sensor's are calibrated successively and attached to GPIO Pin of Arduino UNO.
- All Sensors are successively wired to PCB board and are connected directly component's window as explained in the architecture illustration.
- Then we integrate and calibrate the three sensors that detect gases and temperature and humidity respectively with Arduino UNO before the data detected is sent to the controller module.

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MODULE – 2

Integration of Data b/w Servers (Private Cloud and Government) with sensors

Technical Description

- In this system, we integrate the data between both the servers i.e. Public and Private Cloud through google firebase respectively with Arduino UNO before the data detected is sent to the controller module.
- Both the Cloud's are synced successively and are connected directly component's window as explained in the architecture illustration.
- The Sensor Values are updated to two server rooms (Factory Server and TNPCB Government Server) and are constantly stored in cloud database using Firebase.

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MODULE – 3

Real Time Data Interpretation and Live Action of Power Outage Relay

Technical Description

- Processor getting abnormal values from sensors it will activate buzzer sound reflected from both Government's and Organization's cloud server.
- The two step process happening at this juncture are:

1. TNPCB would send one warning message to factory's authoritative pollution level manager.
2. In case the company doesn't make any pollution controlling process ,the power supply of the Factory unit is disrupted and the license will be canceled by TNPCB.

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Sensors Integration & Arrangement

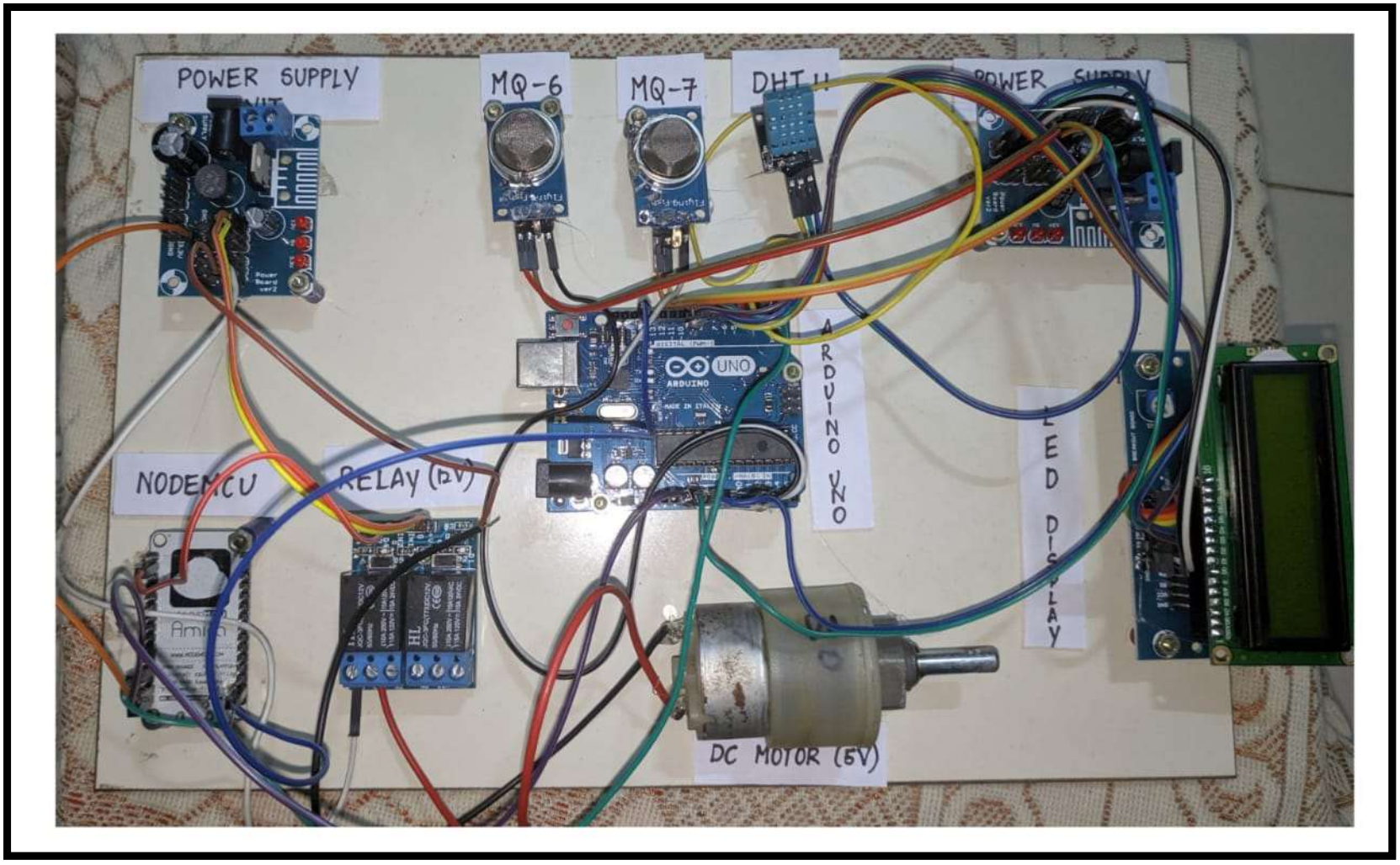
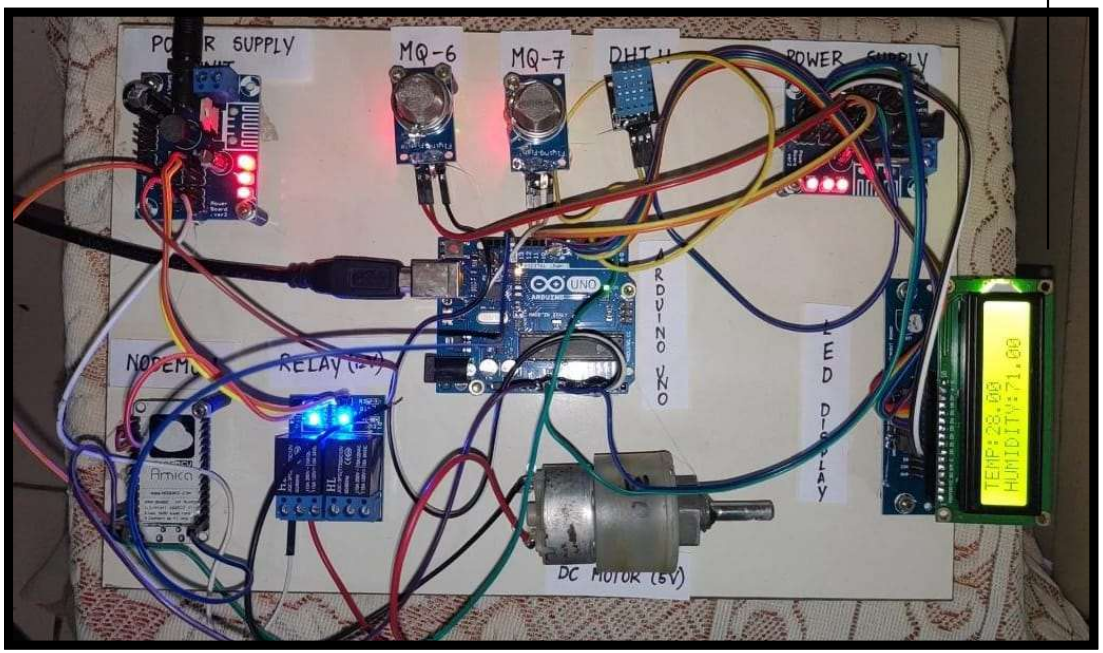


Fig. 5 – Sensors Integration & Arrangement

Final Module Demo

Fig. 6 – Real-time Readings Observed

Fig. 7 – Module When Completely Powered ON



*Firebase Details
Using Firebase in Spark Plan - 1Gb Free Data can be used

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Screenshots Demo of Applications

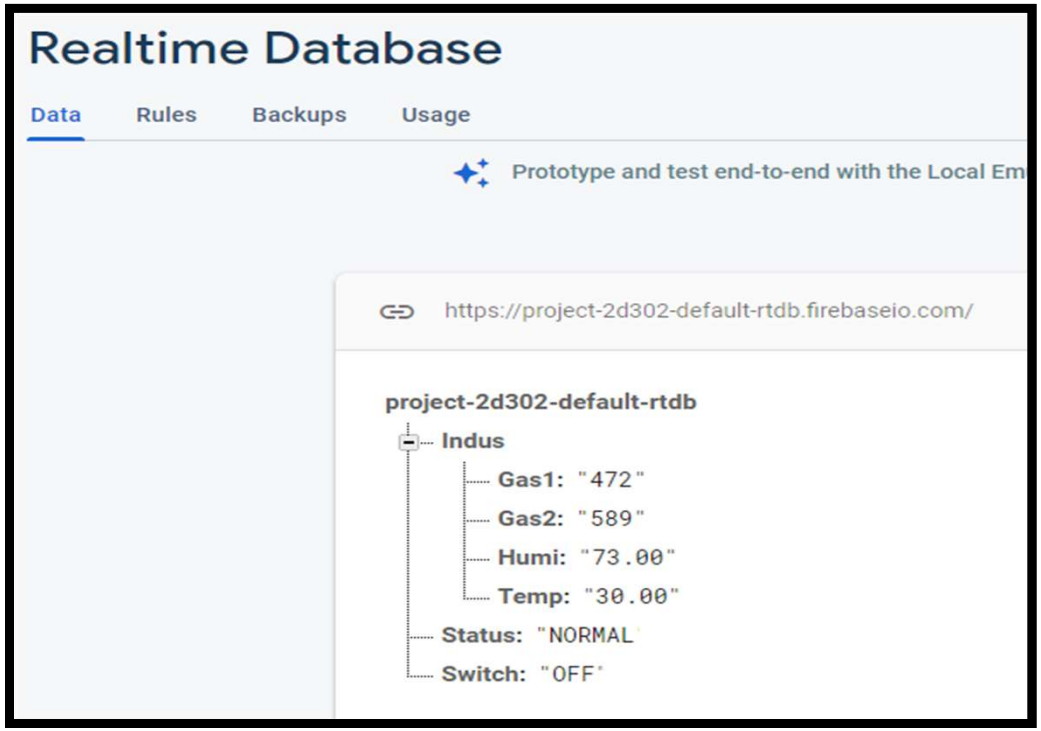

Fig. 8 – Firebase Realtime Database

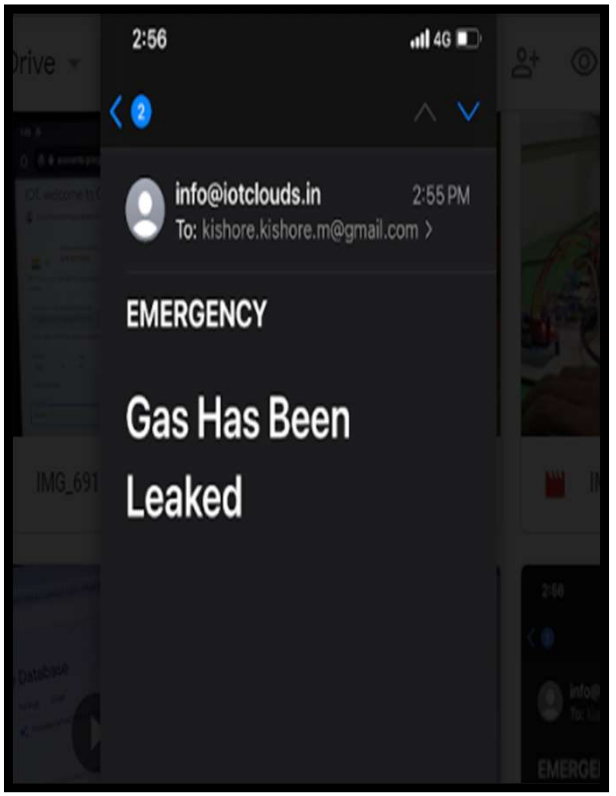

Fig. 9 – Mail Received from Gov Server

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Screenshots Demo of Applications

Web Application

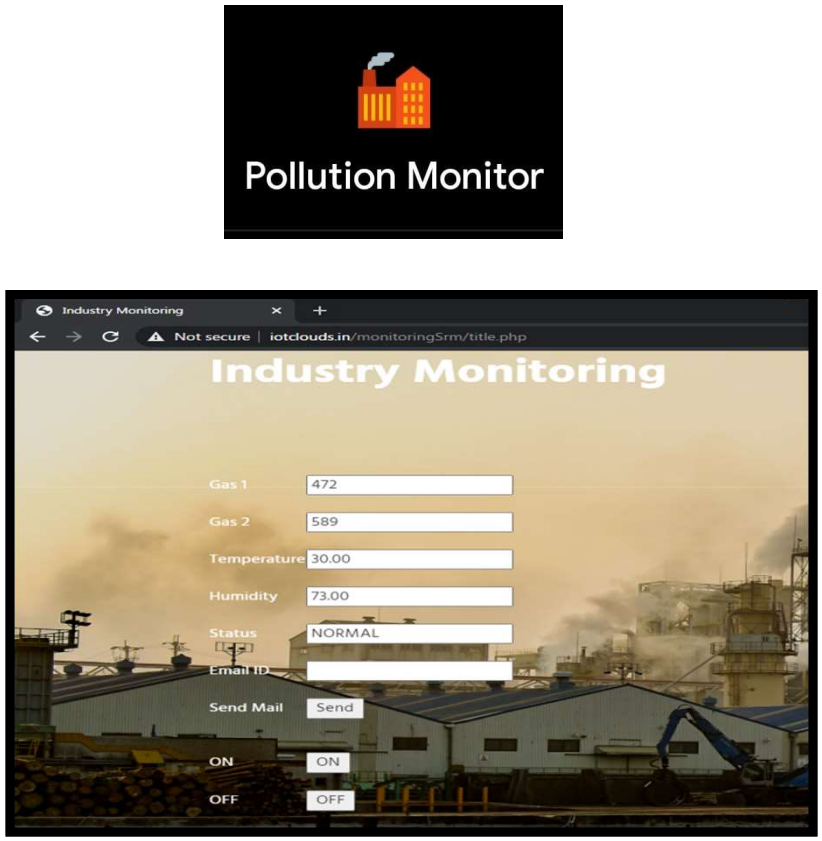

Fig. 10 –Webpage for the Government End

Mobile Application

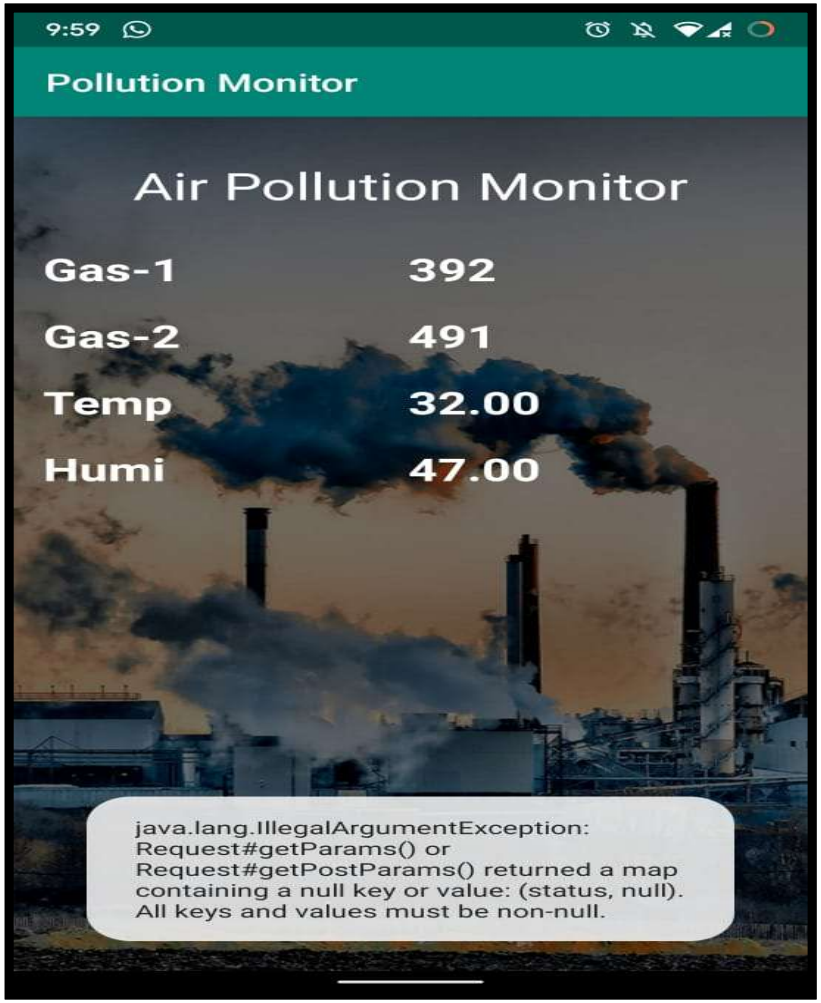

Fig. 11– APK Working Screenshot & Readings Observed

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RESULTS AND DISCUSSIONS

- The Prototype of Module – "IoT Based Smart Industry Monitoring and Alerting System" is successfully designed
- Both the Clouds are synced successively and are connected directly in real-time which are used to monitor, locate and successively alert gas leaks of a complex factory thus, controlling the pollution.
- The Sensor Values are updated to two server rooms (Factory Server and TNPCB Government Server) and are constantly stored in cloud database using Firebase.
- Able to monitor and identify the changes in real-time.
- Detects Temperature, humidity, level of leaked harmful gases from industrial premises successfully

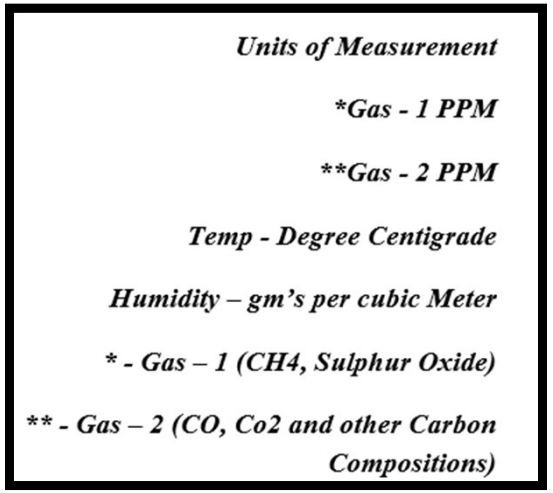

Fig. 12 – Units of Measurement
&
Indexed values

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PUBLICATION DETAILS

Journal Name : Springer: Lecture Notes in Electrical Engineering (https://www.springer.com/series/7818)
ISSN: 1876-1100.

Conference : International Research Conference on IOT, Cloud and Data Science **(IRCICD' 21)**

*** IRCICD' 21 – BOA Souvenir Attached – Page - 27**

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PUBLICATION DETAILS

International Research Conference on IoT, Cloud & Data Science (IRCICD '21)

IOT BASED SMART INDUSTRY MONITORING AND ALERTING SYSTEM

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Abstract — With the advanced computer innovation and automation, the industries across the world have undergone a major revolution. This led to the increased living standards of the commoner and contributed to the country's economic growth. IoT has transformed itself to suit various fields, namely home automation, smart devices, and significantly contributing to the healthcare sector. IoT provides a perfect solution for cost reduction over to 1/10th of the conventional systems. IoT also effectively increases the productivity and efficiency of any industry, thus contributing to its development. Unlike Traditional Systems, we have used IoT technology to make a Smart Industry Monitoring and Alerting System and perform data analytics on sensor readings using cloud service successively. This will detect any leakage of harmful gases, and thus reports the details of the leakage effectively. This model's vision is to develop a system that automatically senses and alerts the corresponding officials, thus stopping gas leakages in those permeable areas. Throughout this paper, our prototype's technological advantages – "IoT Based Smart Industry Monitoring and Alerting System" are being explored.

Keywords — Air pollution, IOT, Sensors, Monitoring systems, Web-Server Based Applications, Internet, Big Data, Cloud, Wireless technology, Gas emission Sensing, Industrial applications.

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International Research Conference on IoT, Cloud and Data Science (IRCICD'21)

Certificate of Participation

This is to certify that

Ms. RAMYA RAMAKRISHNAN

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

has participated and presented a paper titled

IOT BASED SMART INDUSTRY MONITORING AND ALERTING SYSTEM

in the Virtual International Research Conference on IoT, Cloud and Data Science (IRCICD'21) Organised by the Department of Computer Science and Engineering, SRM Institute of Science and Technology, Vadapalani, Chennai, Tamil Nadu, India held on 23rd and 24th April 2021.

Dr. M Durgadevi	Dr. G. Paavai Anand	Dr. S. Prasanna Devi	Dr. C. Gomathy	Dr. K. Duraivelu
Organizing Secretary	Organizing Secretary	HOD / CSE	VP Academics (E&T)	Dean (E&T) - VDP

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Mr. K SAIVARUN

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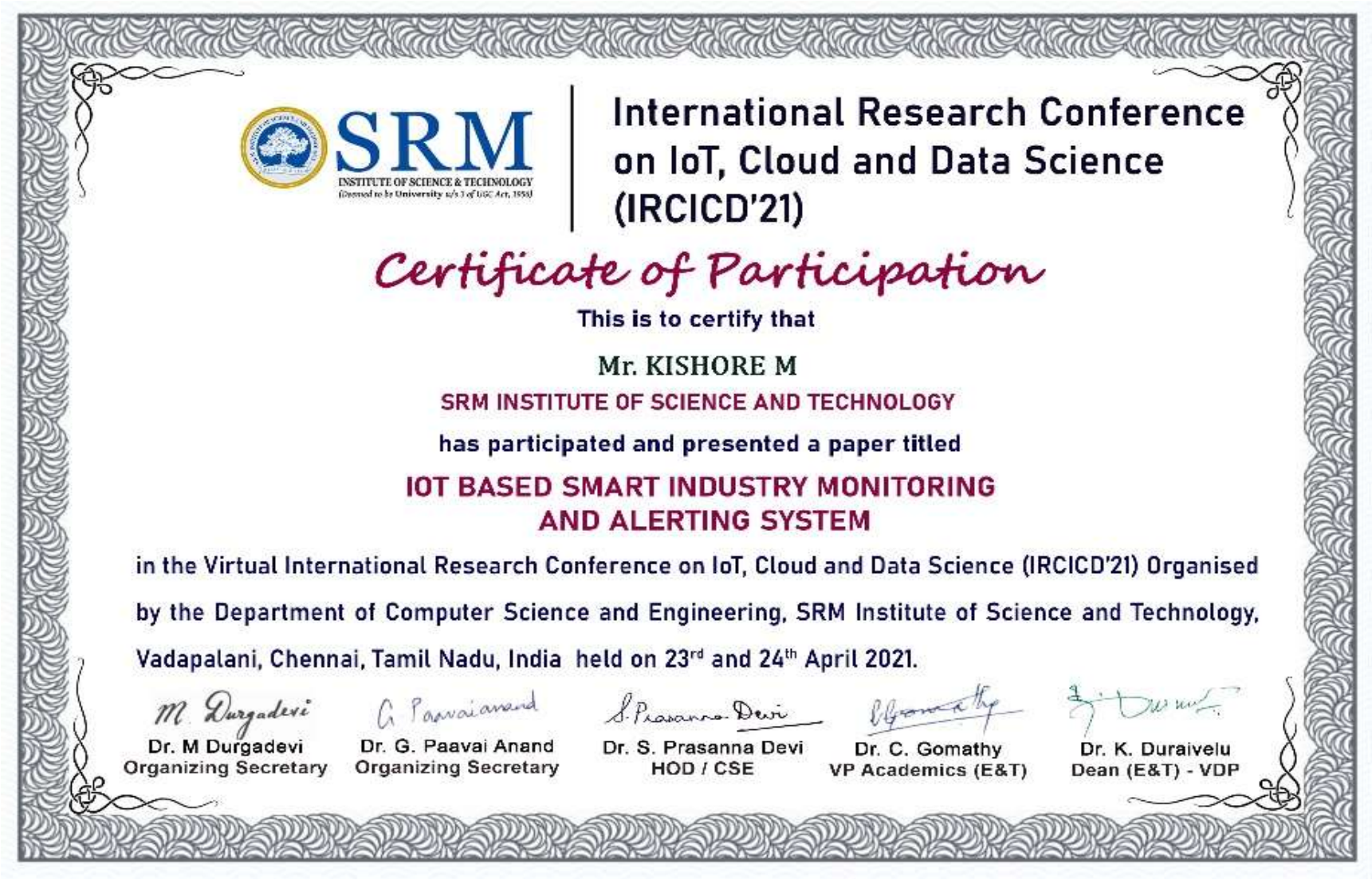

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PAYMENT RECEIPT & ATTENDANCE CERTIFICATE

Date: 23/04/2021 Receipt No: IRCICD0191

Received with thanks From K SAIVARUN, RAMYA RAMAKRISHNAN, KISHORE M, Dr. KATHIRVEL A a sum of Rs. 10000 (Rs. 9500 towards Journal Publication and Rs. 500 towards conference registration) for their paper titled IOT BASED SMART INDUSTRY MONITORING AND ALERTING SYSTEM with paper-id IRCICD_2021_paper_191 presented in the virtual INTERNATIONAL RESEARCH CONFERENCE ON IOT, CLOUD AND DATA SCIENCE 2021, Organized by Department of Computer Science & Engineering held on 23rd & 24th April 20121 vide Money Transfer.

G. Parvaiavand

Signature of Authorized signatory

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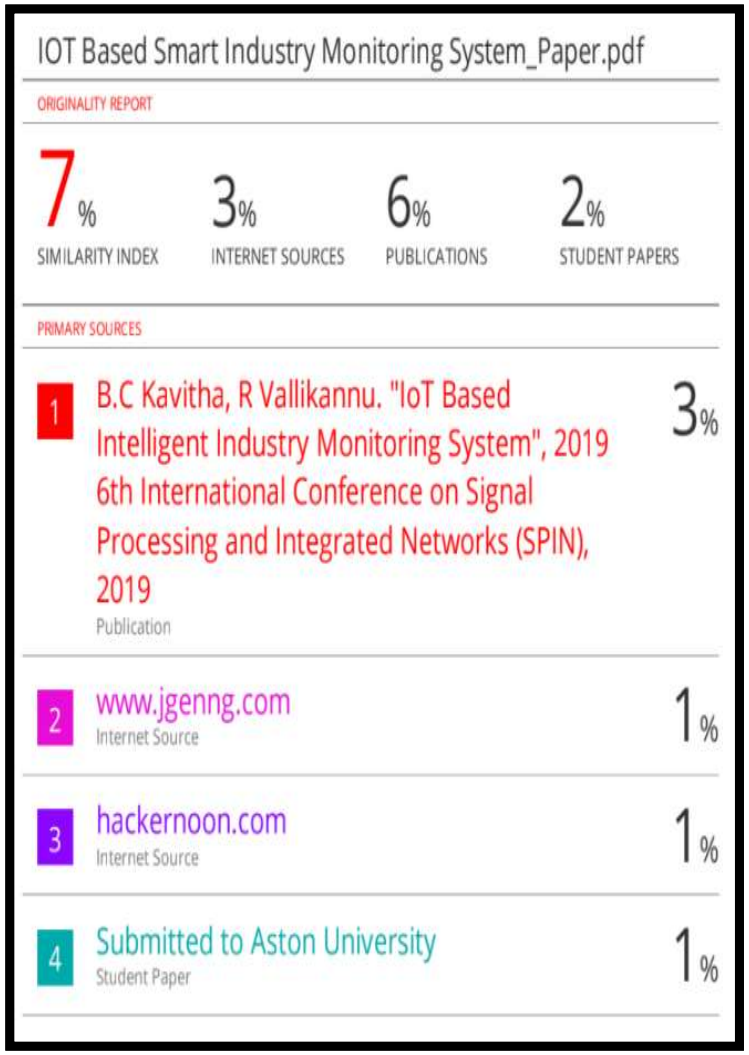
PLAGIARISM REPORT

Paper Published in IRCICD'21



IOT Based Smart Industry Monitoring System_Paper.pdf

ORIGINALITY REPORT

7%	3%	6%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	B.C Kavitha, R Vallikannu. "IoT Based Intelligent Industry Monitoring System", 2019 6th International Conference on Signal Processing and Integrated Networks (SPIN), 2019 Publication	3%
2	www.jgenng.com Internet Source	1%
3	hackernoon.com Internet Source	1%
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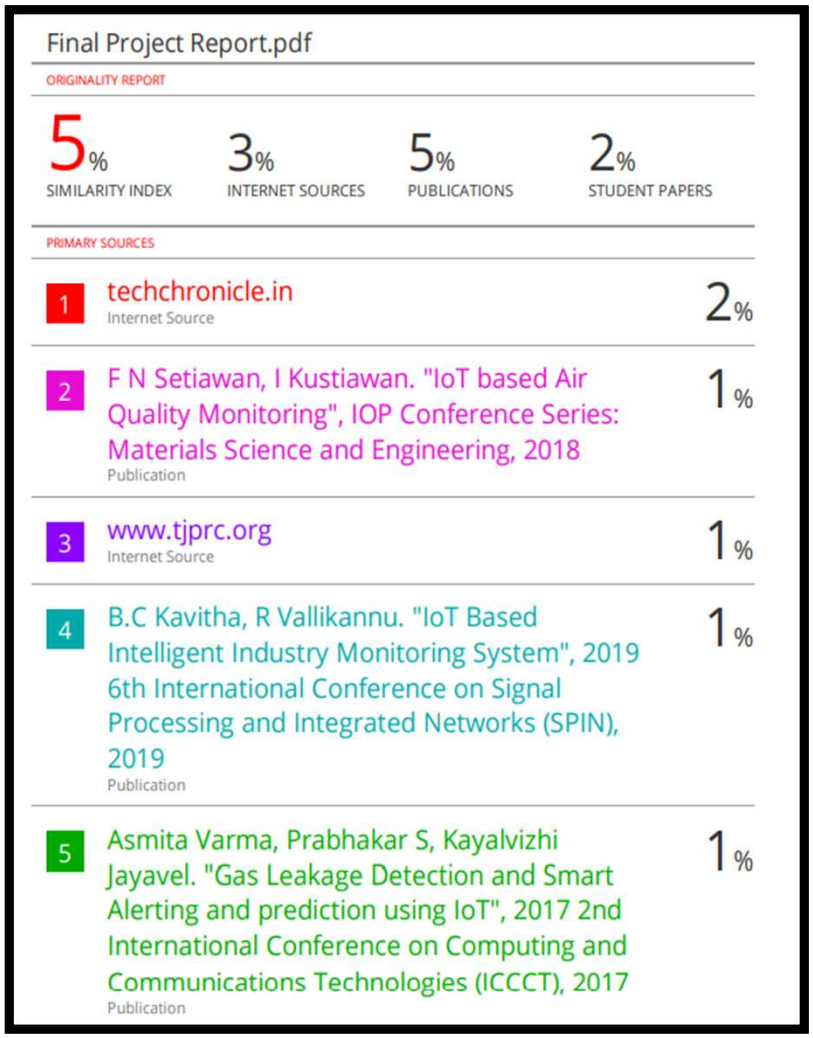

Final Project Report.pdf

ORIGINALITY REPORT

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PRIMARY SOURCES

1	techchronicle.in Internet Source	2%
2	F N Setiawan, I Kustiawan. "IoT based Air Quality Monitoring", IOP Conference Series: Materials Science and Engineering, 2018 Publication	1%
3	www.tjprc.org Internet Source	1%
4	B.C Kavitha, R Vallikannu. "IoT Based Intelligent Industry Monitoring System", 2019 6th International Conference on Signal Processing and Integrated Networks (SPIN), 2019 Publication	1%
5	Asmita Varma, Prabhakar S, Kayalvizhi Jayavel. "Gas Leakage Detection and Smart Alerting and prediction using IoT", 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), 2017 Publication	1%

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Originality

- Unlike Traditional Systems, we've used IoT technology to make a Smart Industry Monitoring and Alerting System and to perform data analytics on sensor readings using cloud service successively.

- With our system now even the authorities of the Government can directly take part in the system of controlling pollutants and make a sustainable surrounding factory environment.

Innovation

- This automated system, as soon as set up is able to constantly monitor the pollutants stage and analyses the detected information.
- The maximum highlighting function of this model is that the output is represented in real-time both on mobile phones or even from the webpage.
- The Model is completely green and no longer damage the surroundings in any way.
- Moreover, it's primarily based totally on the current technologies and additionally cheaper compared to various other technologies evolved so far. Thus, it can be provisioned efficiently.

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Percentage of Work Completion at the time of Submission of Project Report

100 % of work is completed as per the original plan at the time of submission.

(i.e)

This includes

↓

Successive Implementation
Testing
Generating Desired Outputs
&
Obtaining the results as per the Proposed Project Model

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Highlighting the Originality of our Project

- Unlike Traditional Systems, we've used IoT technology to make a Smart Industry Monitoring and Alerting System and to perform data analytics on sensor readings using cloud service successively.
- With the assist of this tool even the authorities can take part withinside the system of controlling pollutants and make certain secure surroundings.
- This automated version, as soon as set up is able to constantly monitor the pollutants stage and analyses the detected information.
- The maximum highlighting function of this tool is that the output is represented in real-time and handy on Mobile Phones or even from the webpage.
- Moreover, it's far primarily based totally on one of the current technologies and additionally cheaper compared to different technology evolved thus far and may be set up efficiently.

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"In your team's view what is the innovation / new idea / concept / technique that can be highlighted in your project"

The Following are the new ideas implemented in our project :-

- Unlike Traditional Systems, we've used IoT technology to make a Smart Industry Monitoring and Alerting System and to perform data analytics on sensor readings using cloud service successively.

- This will detect any leakage of harmful gases, supporting and displaying the level and the location of the leakage.

- Hence we've developed a device that can automatically detect leakage of gases and rise in temperatures and alert the corresponding officials thus, stopping gas leakages and temperature rise in those permeable areas.

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What mathematical / software Tools were used for design / analysis / simulation/ testing etc

Software's Tools Used for Programming

- Language Programmed - C++, Java
- Arduino Uno IDE
- Android Studio, VS Code
- Google Firebase Realtime Console
- Android Mobile – (Version 4.4+)
- Windows Laptop for working

Hardware's / Devices Used in Implementation

- NODEMCU
- LCD 16*2
- Arduino UNO
- GAS Sensor
- Temperature Sensors
- Humidity sensor
- Relay
- Buzzer
- Power unit
- DC Motor (Factory Representation)

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Contribution by Individual Team Members

- **RA1711003040001 – Ramya Ramakrishnan**

  Worked on Sensor Integration and Calibration – Arduino UNO Pin Configuration and NODEMCU Connection Establishment.

- **RA1711003040117 – K Saivarun**

  Worked on Firebase Console Configuration and Integration of Real-time Data between Private Cloud and Government Side Cloud.

- **RA1711003040141 – M Kishore**

  Worked on Backend Webpage Development (Government Page) and Mobile Application Deployment (Client Side - APK)

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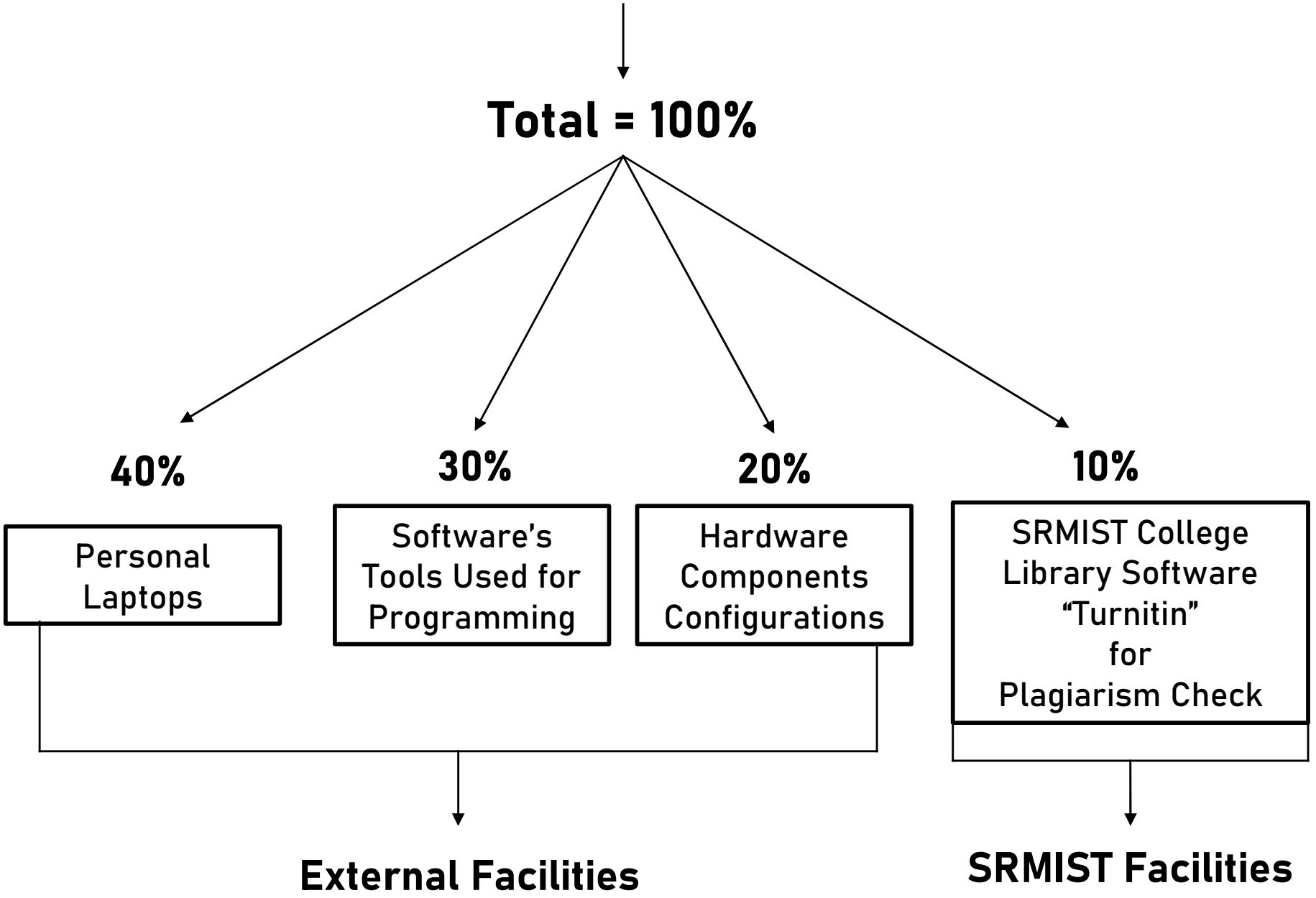
PERCENTAGE OF WORK COMPLETED



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"Challenges faced during the execution of the project and how it was resolved"

- The integration and deployment various sensors posed a challenge. Here, for the gas sensors there was a problem of cross-sensitivity in other base papers ,but through effective collaboration we've deployed collective gas detecting sensors(MQ-6 and MQ-7) to complete the task successfully.
- Our objective was clear, but the approach for proceeding each module was very challenging. By the guidance of our guide through effective discussions and planning helped us to overcome our challenge.
- To make our model run without any supervision, we made various attempts in reducing latency between each process. Thus, by achieving a real-time operating model initiating preventive actions by abnormalities found in the received data efficiently.

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FUTURE WORK

- Predictive maintenance is an upcoming industrial need, for which the proposed model can be improvised. In case of gas leakage, the concentration of gas varies from point to point which can be analysed. These cases can open an eye for the budding researchers.

" The best way to predict **future** is to create it." ...

- Our Goal for a Sustainable Future

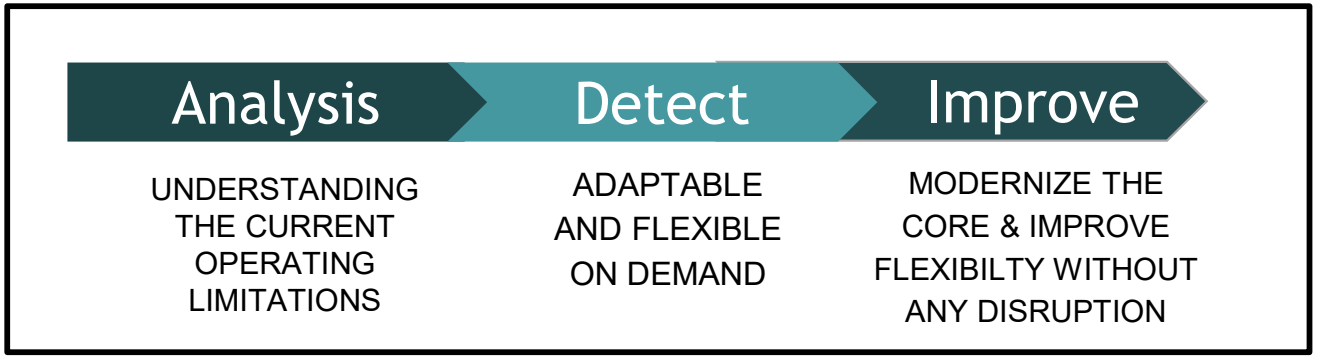

Fig. 13 – Future Scope and Trends for Improving our model

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REFERENCES

[1] A Boubrima, W Bechkit, and H Rivano 2017 A new WSN deployment approach for air pollution monitoring, 2017 14th IEEE Annu. Consum. Commun. Netw. Conf. CCNC 2017, pp. 455– 460

[2] B Bathiya 2016 Air Pollution Monitoring Using Wireless Sensor Network 2016 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE) 19- 21 December 2016

[3] A Škraba, A Koložvari, D Kofjač, R Stojanović, V Stanovov, and E Semenkin 2016 Streaming pulse data to the cloud with bluetooth le or NODEMCU ESP8266 2016 5th Mediterr. Conf. Embed. Comput. MECO 2016 - Incl. ECyPS 2016, BIOENG.MED 2016, MECO Student Chall. 2016, pp. 428–431, 2016

[4] K Keshamoni and S Hemanth 2017 Smart gas level monitoring, booking & gas leakage detector over iot Proc. - 7th IEEE Int. Adv. Comput. Conf. IACC 2017, pp. 330–332

[5] D Spirjakin, A M Baranov, and V Sleptsov 2015 Design of smart dust sensor node for combustible gas leakage monitoring Proc. 2015 Fed. Conf. Comput. Sci. Inf. Syst. FedCSIS 2015, vol. 5, pp. 1279–1283, 2015

[6] Anil H. Sonune, S.M.Hambarde,-" Monitoring and Controlling of Air Pollution Using Intelligent Control System",- International Journal of Scientific Engineering and Technology ISSN: 2277-1581,Volume No.4 Issue No5, pp: 310-313.

[7] Nikheel A. Chourasia, Surekha P. Washimkar," ZigBeeBased Wireless Air Pollution Monitoring" InternationalConference on Computing and Control Engineering(ICCCE 2012), 12 & 13 April, 2012

[8] Luay Friwan, Khaldon Lweesy , Aya Bani-Salma , Nour Mani. “A Wireless Home Safety Gas Leakage Detection System”, IEEE 2011.

[9] Ankit Sood, Babalu Sonkar, Atul Ranjan, Ameer Faisal, “Microcontroller Based LPG Gas Leakage DetectorUsinbg GSM Module, International Journal of Electrical and Electronics Research, Vol.3 , Issue.2 , pp: (264-269) ,Month: April- June 2015.

[10] D.Yaswanth, Dr Syed Umar,-" A Study on Pollution Monitoring system inWireless Sensor Networks",- D.Yaswanth et al | IJCSET |September 2013 | Vol 3, Issue 9, 324-328.