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# Industrial monitoring system

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## ABSTRACT

***In our project, we are trying to implement IoT in the manufacturing area for monitoring the industries and obtaining the crucial data that can be used to implement automated decisions using machine learning for the safety of the workers in an industry an increasing the productivity and efficiency of an Industry. Also, we will discuss some the current trends in the Industrial IoT or Industry 4.0 and see If there could be any improvement that can be done in this sector and discuss challenges we can face in implementing IoT and how can be these challenges be addressed. Industry4.0 is a name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Industry 4.0 is considered as the fourth industrial revolution. All these, when implemented to a Manufacturing Industry, can improve the production system and Safety of an Industry.***

***Keywords***— *Industrial IoT, IoT, Industry 4.0, Embedded system*

## 1. INTRODUCTION

The Internet of Things (IoT) is the extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled [1].These Sensors can be used to collect data over the internet and use that data to retrieve information with the use of technologies such as big data and artificial intelligence. IoT is being used in various sectors such as consumer markets for making consumer goods, in agriculture to monitor and control various agricultural processes and now with the ease of use of IoT more and more research in this field. Now in this project, we are trying to demonstrate Industry 4.0 which is a name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the internet of things, cloud computing and cognitive computing etc. Industry 4.0 is commonly referred to as the fourth industrial revolution which will use the current computer engineering trends to increase the productivity and safety in the manufacturing Industries. We will try to discuss all these topics in detail in the following topics especially The Industrial Internet of Things (IIoT) which refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications. This connectivity allows for data collection, exchange and analysis, potentially facilitating improvements in productivity and efficiency as well as other economic benefits. The IIoT is an evolution of a Distributed Control System (DCS) that allows for a higher degree of automation by using cloud computing to refine and optimize the process controls. In this project, we are making an industrial monitoring system which will use different sensors to monitor the various areas of the industry. For connecting these sensors and controlling them we are going to use Raspberry Pi which is a low-cost credit card sized computer that plugs into computer monitor or TV and uses a standard keyboard and mouse. This credit card sized computer can be used to connect different sensors together and also can be processed using its computational power even it can also be connected to the internet using the LAN wire as well it has Wi-Fi to connect the sensors to the internet and even using the cloud services with the use of the internet. With its ability to connecting to the internet, it can easily use the cloud services for the increasing computational power for the heavier computational services like machine learning.

## 2. PURPOSE OF PROJECT

The purpose of this project is to provide industries with best in class technologies so that they can produce good profits and hence increase the economy of the nation. By using IoT in industries we are widening the area of development and progress in the Industrial area.

## 3. EXISTING SYSTEM

The existing system in an industry as we all know the use of robotics is implemented in the industries that means more and more sectors of an industry is automated but still it requires monitoring to check in any malfunctioning of any machine which is now only done by a human and a human might skip the vital information which could cost a company and hence the system is not fully secure, therefore we are presenting an automated monitoring system.

## 4. PROPOSED SYSTEM

The system we are developing is an automated monitoring system in which with the help of different sensors and a micro-controller we are going to monitor all the vital sections of an industry without any help of the human body. And whenever there is a possible malfunction or an anomaly noted our system will inform the concerned party.

## 5. IoT, INDUSTRIAL IoT AND INDUSTRY 4.0

IoT can be defined as the things connecting to each other with the use of the internet. These 'things' are smart consumer electronic devices like TV, fridge, air conditioner and any other object which can be useful if is connected to the internet and used to communicate in order to improve human awareness of the surrounding environment, saving time and money. But in the case of industries, we are assisting in the advent of the digital and smart manufacturing, which aim at integrating Operational Technology (OT) with Information Technology (IT). Connecting all the industrial assets, including machines and control systems, with the information systems and the business processes. As a consequence, the large amount of data collected can feed analytic solutions and lead to optimal industrial operations. On the other hand, smart manufacturing obviously focuses on the manufacturing stage of (smart) products life-cycle, with the goal of quickly and dynamically respond to demand changes. Therefore, the IIoT affects all the industrial value chain and is a requirement for smart manufacturing. Communication in IIoT is machine oriented and can range across a large variety of different market sectors and activities. The IIoT scenarios include legacy monitoring applications (e.g., process monitoring in production plants) and innovative approaches for self-organizing systems (an e.g., autonomic industrial plant that requires little, if any, human intervention). While the most general communication requirements of IoT and IIoT are similar, e.g. support for the Internet ecosystem using low-cost, resource-constrained devices and network scalability, many communication requirements are specific to each domain and can be very different, e.g. Quality of Service (QoS) (in terms of determinism, latency, throughput, etc.), the availability and reliability, and the security and privacy. IoT focuses more on the design of new communication standards which can connect novel devices into the Internet ecosystem in a flexible and user-friendly way. By contrast, the current design of IIoT emphasizes on possible integration and interconnection of once isolated plants and working islands or even machinery, thus offering a more efficient production and new services. For this reason, compared with IoT, IIoT can be considered more an evolution rather than a revolution.

Regarding the connectivity and criticality, IoT is more flexible, allowing ad hoc and mobile network structures, and having less stringent timing and reliability requirements (except for medical applications). On the other hand, IIoT typically employs fixed and infrastructure-based network solutions that are well designed to match communication and coexistence needs. In IIoT, communications are in the form of machine-to-machine links that have to satisfy stringent requirements in terms of timeliness and reliability. Taking process automation as an example domain where process monitoring and control applications can be grouped into three sub-categories: monitoring/supervision, closed-loop control, and interlocking and control. While monitoring and supervision applications are less sensitive to packet loss and jitter and can tolerate transmission delay at the second level, closed-loop control and interlocking and control applications require bounded delay at millisecond level (10-100ms) and transmission reliability of 99.99 %.

Comparing the data volume, the generated data from IoT is heavily application dependent, while IIoT currently targets at analytics, e.g. for predictive maintenance and improved logistics. This implies that a very large amount of data are exchanged in IIoT. For example, it is reported that the Rio Tinto mine generates up to 2.4TB of data per minute, according to the Cisco Global Cloud Index.

Since the beginning of industrialization, from time to time, a technological leap takes place that revolutionizes the concept of industrial production, being refer to as industrial revolutions: First industrial revolution took place in the field of mechanization and steam engines; second industrial revolution was based in the intensive use of electrical energy and mass production, and third industrial revolution was founded in the IT environment and the widespread of digitalization. The concept of Industry 4.0 (where 4.0 represents the fourth industrial revolution) arises when the IoT paradigm is merged with the Cyber-Physical Systems (CPSs), cloud services, artificial intelligence and big data together. Originally defined in Germany, the Industry 4.0 concept has gained global visibility and it is nowadays universally adopted for addressing the use of Internet technologies to improve production efficiency by means of smart services in smart factories. CPSs extend real-world, physical objects by interconnecting them all together and providing their digital descriptions. Such information, stored in models and data objects that can be updated in real time, represents a second identity of the object itself and constitutes a sort of "digital twin". Thanks to the dynamic nature of these digital twins, innovative services, that were not possible in the past, can be implemented across the whole product lifecycle, from inception to disposal of manufactured products. In summary, IIoT is a subset of IoT which is specific to industrial applications. The manufacturing phase of the product lifecycle is where the IoT and Industry 4.0 meet, originating to the IIoT. Figure 1 shows the intersections of IoT, CPS, IIoT, and Industry 4.0.

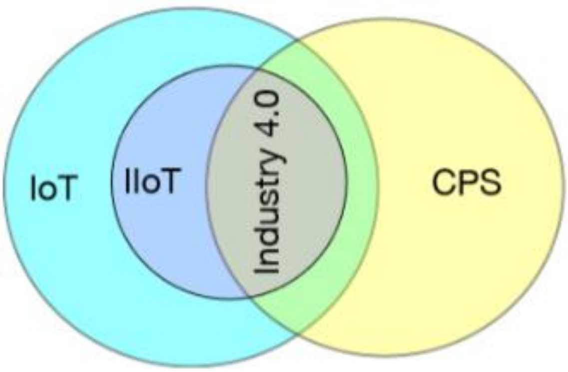


**Fig. 1: IoT, CPS, IIoT and Industry 4.0 Venn diagram**

### 5.1 Cyber-Physical System

Such systems that bridge the cyber-world of computing and communications with the physical world are referred to as cyber-physical systems. Cyber-Physical Systems (CPS) are physical and engineered systems whose operations are monitored, coordinated, controlled and integrated by a computing and communication core. This intimate coupling between the cyber and physical will be manifested from the nano-world to large-scale wide-area systems of systems. The internet transformed how humans interact and communicate with one another, revolutionized how and where information is accessed and even changed how people buy and sell products. Similarly, CPS will transform how humans interact with and control the physical world around us. Consequently, the ever-growing use of sensors and networked machines has resulted in the continuous generation of high volume data which is known as Big Data (We will discuss a bit about big data below) CPS can be further developed for managing Big Data and leveraging the interconnectivity of machines to reach the goal of intelligent, resilient and self-adaptable machines. Furthermore, by integrating CPS with production, logistics and services in the current industrial practices, it would transform today's factories into an Industry 4.0 factory with significant economic potential. For instance, a joint report by the Fraunhofer Institute and the industry association Bitkom said that German gross value can be boosted by a cumulative 267 billion euros by 2025 after introducing Industry 4.0.

**5.2 Artificial intelligence and machine learning**

When any system is able to perform an action by its own without the help of any human intervention it is called as Artificial Intelligence. The new industrial environment will benefit from several tools and applications that complement the real formation of a smart, embedded system that is able to perform autonomous tasks. An advanced digitalized network in factories that monitors this information, next logical step leads to the combination of internet technologies and "smart" objects to interpret this huge flow of information towards an advanced form of manufacturing, where, for example, it would be possible to foresee the need for preventive actions and adapt production before it happens. Providing with the data collecting from various sensors and analysing that big data to convert into information so that it can be used for training the systems. This is the step that is not included in our project but it can be useful along with the big data.

**5.3 Big data**

Data management and distribution in Big Data environment are critical for achieving self-aware and self-learning machines. The importance of leveraging additional flexibility and capabilities offered by cloud computing is inevitable, but adapting prognostics and health management algorithms to efficiently implement current data management technologies requires further research and development.

Also, it is very important to utilize technologies such as cloud computing to improve the scope of industry 4.0.

## 6. SYSTEM ANALYSIS

**6.1 Objective**

The hardware sensor data gathered from the hardware unit of Raspberry Pi will be sent to the python program which will display the data from the surrounding and it will continuously check the surroundings and whenever there is an anomaly occurring it will send an E-Mail to the registered Email address so that the action can be taken on that system. All the sensors at all the times will be collecting the data and this data can be saved and provided to the neural network to perform machine learning if necessary.

**6.2 Background**

The Internet of Things is the system of physical articles gadgets, vehicles, structures and different things installed with hardware, programming, sensors, and system network that empowers these items to gather and trade information. The Internet of Things has been characterized in Recommendation ITU-T Y.2060 (06/2012) as a worldwide framework for the data society, empowering propelled benefits by interconnecting (physical and virtual) things dependent on existing and advancing interoperable data and correspondence advances. Building a loT of application requires the correct choice and blend of sensors, systems and correspondence modules. The above setup is teamed with the four sensors which are a temperature sensor, a piezoelectric sensor for the pressure, a MEMS sensor to check the position and finally a gas sensor to check the leakage of gas. Respondents said that they have conveyed or plan to utilize a loT in numerous zones, including resource following, security, armada the executives, field drive the board, vitality information the executives, and condition-based observing. The part has wide applications in the fields of transportation, way of life, building, horticulture, industrial facility, medicinal services and some more. Usually depicted as a system of systems. This monitoring system is used to catch the anomaly before it happens and the placement of the sensor is very important to catch the anomaly and to perfectly saving the system and hence a very deep study of the factory is necessary before applying this, therefore, every factory will its own way of application of Industrial IoT.

**6.3 Rationale**

The purpose behind this project is to monitor the industries to make sure that they are a safe to place for the workers working there and also to make sure that the industries grow in the business to increase the productivity and efficiency. This system has MP3008 sensor which is an analogue to digital converter which is used to convert the signals from analog sensors like the gas sensor which will be monitoring the gas leakage at every time system is on and working. Therefore with leakage of gas, we can trigger other functions as well to switch on fire alarms or blocking the gas intake this could prevent the accidents before happening as there is old saying "prevention is better than cure" if we can prevent it from happening why shouldn't we.

**6.4 Challenges and opportunities**

Designing the ideal IoT system contains challenges and new opportunities to overcome these challenges. Failure of the system is the opportunity to make a new and better system. The industries are already a step towards using the IoT for many things like in agriculture and healthcare and manufacturing industries are also are stepping in this arena of the massive amount of opportunities. Industrial IoT using these sensors can enhance the efficiency, safety, and working conditions for the workers. For example, using Unmanned Aerial Vehicles (UAVs) allows inspecting oil pipelines, monitoring food safety using sensors, and minimizing workers' exposure to noise, and hazardous gases or chemicals in industrial environments.

Despite the great challenges, there are many challenges in realizing the opportunities which should be addressed in future research. The key challenges are in the fields of energy efficiency operation, real-time performance in dynamic environments, the need for coexistence and interoperability and maintaining the security of the application and users privacy.

**6.5 Working**

The main system in our hardware is the Raspberry Pi 3 and the MCP3008 analog to digital converter and the sensors. First we switch on the raspberry pi connect in to the internet through Wi-Fi or LAN so that it could use the cloud services and Email services after that the program is run through command prompt which triggers all the sensors and then the sensors collect the data from the environment and continuously check whether something abnormal is happening and triggering the given email address if something abnormal does happen.

The email will be sent to the registered email when the following conditions occur:
1. In MEMS Sensor if
x-axis>600 or y-axis>700 or z-axis>550
2. In Temperature sensor, if
temp> 100-degree Celsius
3. In Gas Sensor if
GAS>300 m^3
4. In Pressure sensor, if
piezo>300 Pascal

These conditions are checked continuously and as long as this is triggered mail is sent to the user. This was the working of our project.

### 6.6 Block diagram

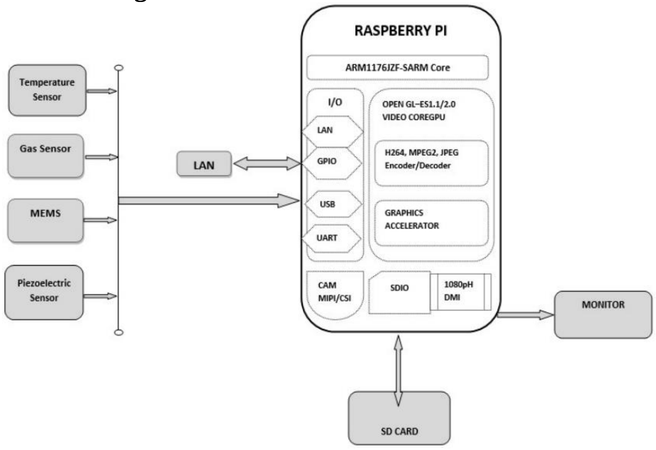


**Fig. 2: Block Diagram**

Raspberry Pi the most essential part of this diagram it is the central processing and controlling part all the sensors are connected to raspberry through an ADC. Raspberry Pi does not have an inbuilt ADC or for this, we are using an external ADC IC called MCP3008. All the MCP are connected in one of the eight channel in MCP. MCP can be interfaced with raspberry pi through SPI protocol Raspberry pi connected to the internet through LAN or Wi-Fi. This makes it possible to send the email in case of an anomaly.

### 6.7 Advantages

- The main advantage is of the system is that use through a gas sensor which checks any leakage for the worker's safety.
- Another temperature sensor also checks in sudden increase.
- Any unwanted pressure or movement of any machine is also noted.

## 7. IMPLEMENTATION

### 7.1 General

To implement the program we need to start by opening the command prompt and then change the location to the current working path in our case which is desktop so the command is
cd /pi/home/Desktop

And when the location is changed the program is run through the command: sudo python main.py

To exit the running loop ^c is used

### 7.2 Processes

Processes, digital devices and business systems can support the implementation of the Industrial Internet of Things, from small companies new to the IIoT potential up to large industries that can benefit from adding new sensors into their present systems for internal and external assets. From laying the foundations to help guide future technology investments to easing the integration of the current systems with new controls, automation and data processing benefits, there are ways to help smooth the process and transition for getting the desired results.

### 7.3 Software requirements

**7.3.1 Front-end:** Raspbian OS - It is a Debian-based PC working framework for Raspberry Pi. There are a few forms of Raspbian including Raspbian Stretch and Raspbian Jessie. Since 2015 it has been authoritatively given by the Raspberry Pi Foundation as the essential working framework for the group of Raspberry Pi single-board computers. Raspbian was made by Mike Thompson and Peter Green as a free project. The underlying form was finished in June 2012. The working framework is still under dynamic advancement. Raspbian is exceptionally upgraded for the Raspberry Pi line's low-execution ARM CPUs. Raspbian utilizes PIXEL, Pi Improved X-Window Environment, Lightweight as its fundamental work area condition as of the most recent update. It is made out of an adjusted LXDE work area condition and the Open box stacking window chief with another topic and a couple of different changes. The dispersion is sent with a duplicate of PC variable based math program Mathematic and a rendition of mine craft called Mine craft Pi just as a lightweight form of Chromium as of the most recent adaptation.

**7.3.2 Back-end:** Python Programming - Python is a translated, high-level state, universally useful programming language. Made by Guido van Rossum and first discharged in 1991, Python has a structured reasoning that underscores code clarity, remarkably utilizing critical whitespace. It gives develops that empower clear programming on both little and extensive scales. Van Rossum drove the language network until venturing down as pioneer in July 2018. Python includes a dynamic kind framework and programmed memory of the executives. It bolsters various programming ideal models, including object-situated, basic, utilitarian and procedural. It additionally has an exhaustive standard library. Python mediators are accessible to some working frameworks. C-Python, the reference execution of Python, is open source programming and has a network-based advancement show, as do almost the majority of Python's different usage. Python and C-Python are overseen by the non-benefit Python Software Foundation.

## 8. CONCLUSION

In this report, we have discussed the implementation of IoT in the manufacturing area for monitoring the industries and obtained the crucial data that can be used to monitor the industry which will increase the safety of the workers. It will also help in increasing the productivity and efficiency of the industry. We discussed the important concepts related to the Industrial IoT its challenges and the opportunities it brings in towards the future. It is a growing field and it will keep on growing when the people who care for this industrial sector of the society works towards it. also, we will discuss some the current trends in the Industrial IoT or Industry 4.0 and see If there could be any improvement that can be done in this sector and discuss challenges we can face in implementing IoT and how can be these challenges be addressed. Industry 4.0 should be implemented to a greater extent in our country as well to face the challenges presented by the world and make India a better economy.

 

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