IoT Assisted Optimization of Resources For Healthcare, Mining and Transportation Industry

ABSTRACT

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| **Aims:** The Internet of Things is a futuristic technology that creates a smart system of systems by connecting all electronic devices to one another over the Internet. The Internet of Things facilitates communication between individuals, devices, and other devices. There are numerous uses for this technology in e-Government, business, public administration, and industry. Every organization and industry aims to create its own Internet of Things application to enhance the production of goods and services, customer satisfaction, employee safety, and storage space. This paper explores the role of IoT in resource optimization for healthcare and transportation industries, The creation of IoT-enabled healthcare systems includes sophisticated data processing and large data storage capacities. this integration has been further felicitated by the integration of wireless sensor networks (WSNs) and the Internet of Things (IoT). The mining industry has a diverse setup, and because of infrastructure restrictions in communication, data management, storage, and information exchange, it might be challenging to identify areas where sensor-assisted IoT technology can be useful. While an overall IoT architecture appropriate for the general conditions in the mining industry is still in its early stages, the majority of research efforts to date on applying IoT in the mining industry concentrate on specific issues like ventilation monitoring, accident analysis, fleet and personnel management, tailing dam monitoring, and pre-alarm systems. In the automobile industry, integration of WSN within vehicles can be employed to harness sensor details for smart navigation, quick response, vehicle maintenance and interactive ambience. The logistics of transporting people and goods between cities and towns have been totally transformed by smart mobility. Modern technologies such as the Internet of Things (IoT), artificial intelligence (AI), data analytics, and networking are used in "smart" transportation to enhance many aspects of our transportation networks. These technologies' real-time monitoring, analysis, and decision-making capabilities enable this ecosystem of interconnected automobiles, infrastructure, and customers. Work presents the present scenario of application of IoT in Healthcare and Transportation industry. |

*Keywords:*  *IoT; healthcare, mining, transportation, smart.*

1. **INTRODUCTION**

This paper explores the role of IoT in resource optimization in the transportation, and healthcare industries. The work explores the role of IoT in resource optimization for healthcare and transportation industries, The creation of IoT-enabled healthcare systems includes sophisticated data processing and large data storage capacities. this integration has been further felicitated by the integration of wireless sensor networks (WSNs) and the Internet of Things (IoT). In the automobile industry, integration of WSN within vehicles can be employed to harness sensor details for smart navigation, quick response, vehicle maintenance and interactive ambience. The logistics of transporting people and goods between cities and towns have been totally transformed by smart mobility. Modern technologies such as the Internet of Things (IoT), artificial intelligence (AI), data analytics, and networking are used in "smart" transportation to enhance many aspects of our transportation networks. These technologies' real-time monitoring, analysis, and decision-making capabilities enable this ecosystem of interconnected automobiles, infrastructure, and customers. Work presents the present scenario of application of IoT in Healthcare and Transportation industry. It is possible that smart transportation systems may significantly increase productivity. Intelligent technologies can reduce congestion, enhance traffic flow, and minimize travel times through a variety of means, including predictive analytics, adaptive traffic light controls, and real-time route guidance. As a result, productivity increases, fuel prices decrease, and greenhouse gas emissions decrease.

In the automotive industry, it is suggested that IoT systems may gather data from automobile users to improve vehicle design and can also be used for research purposes to increase efficiency. It can identify parts of the vehicle that need to be replaced and can identify defective parts. In the transportation and logistics industry, it is suggested that GPS and RFID tags be used to track consignment and transport vehicles. The RFID [1] system is the primary element of the medical Internet of things. Both moving and stationary bodies are automatically detected by RFID. Its primary goal is to use the internet to monitor and manage entities. in order to ensure manufacturing efficiency and safety. Old-fashioned broad management must give way to fine management integrating IoT as more and more modern electromechanical equipment is increasingly included into the mining production process. The entire process, including the installation, selection, storage, inspection, and operation of electromechanical equipment, must be conducted in the "control" state and be subject to comprehensive life-cycle management. This can be accomplished by integrating various processes. By connecting RFID and GPS technologies, logistics data management may be accomplished through the internet of things as it grows [3], which can solve a lot of logistics-related issues. In order to ensure the safety of cargo during transportation, this article highlights applications of IoT in the mining, medical, and health industries as well as in cargo transportation management systems that combine RFID, GPS, and GPRS technologies. The mining industry has a diverse setup, and because of infrastructure restrictions in communication, data management, storage, and information exchange, it might be challenging to identify areas where sensor-assisted IoT technology can be useful. While an overall IoT architecture appropriate for the general conditions in the mining industry is still in its early stages, the majority of research efforts to date on applying IoT in the mining industry concentrate on specific issues like ventilation monitoring, accident analysis, fleet and personnel management, tailing dam monitoring, and pre-alarm systems.

1. **IoT in medical and healthcare industry:**

The creation of IoT-enabled healthcare systems includes sophisticated data processing and large data storage capacities. this integration has been further felicitated by the integration of wireless sensor networks (WSNs) and the Internet of Things (IoT). The government is facing a difficulty as the public's need for adequate, affordable, conveniently accessible, and area-specific medical care continues to grow. However, resources are not keeping up with the demand. Technology can assist lessen this issue by bridging the divide between those in need and those with resources. IoT can give patients the greatest medical help in the shortest amount of time and at the lowest possible cost. Additionally, IoT can assist with the manufacturing, shipping, and tracking of pharmaceutical equipment. Additionally, it can be highly helpful in handling medical data, such as infection, sample, and patient medical records. With the aid of the Internet of Things, a platform for remote monitoring of severely ill patients can be built. This platform links all medical devices to gather data from the patient's body, which can then be sent to specialists. Many industries that use disruptive technologies are now innovating using current methods as these technologies gradually become more integrated into daily life. There are several unresolved problems, difficulties, and restrictions associated with IoT in healthcare. Data privacy and security concerns [4], interoperability challenges [5], and the need for standard operating procedures, regulations, and norms [5] are the main areas of concern.

* 1. **Remote monitoring.**

The integration of the Internet of Things (IoT) with remote health monitoring apps is a significant achievement in the diverse landscape presented by the healthcare sector, establishing a new paradigm in the provision of valuable data for patient care and diagnosis. An ecosystem that promotes precision, promptness, and dependability in diagnosis and patient care is made possible by recent models with IoT support, which include wearable technology and portable systems for precise physiological monitoring with seamless connectivity for round-the-clock updates with advanced expert systems [7]. Reading through the most recent research reveals a variety of advancements that work together to improve the dependability and effectiveness of remote health monitoring systems. These advancements play a key role in pushing the limits of technology integration in healthcare.[8]

* 1. **Locating systems**

Healthcare providers can now quickly locate the position of patients, especially in emergency and critical situations, enabling timely medical assistance and lowering the risk of patient harm. Real-time systems with IoT support for locating subjects under monitoring with high accuracy are very much possible with current innovations. Accurate and current information on the locations of healthcare resources is part of the research in locating systems, which goes beyond patient location. By efficiently managing and tracking essential medical resources like supplies, equipment, and prescription drugs, these systems can guarantee their prompt availability, cut down on search time, and avoid inventory shortages or patient care delays. [9, 10]

* 1. **Personalized medicine**

The idea of personalized medicine has become a lifesaver in healthcare thanks to recent advancements. This method offers the potential for more accurate and efficient healthcare by customizing medical therapy to each patient's particular genetic, environmental, and lifestyle characteristics. We do a thorough analysis that looks at the most recent developments and trends in customized medicine in order to obtain a better grasp of the condition of this developing area today. The latest research trends in personal health management systems are shown in Figure 1. [11, 12]



Figure1. Research trends in Personal Health Management System

* 1. **Medical material management and control**

IoT-guided platforms for medical material management can track the manufacture, replication, and distribution of goods like prescription drugs and medical equipment. RFID tags can be used to prevent the duplication of medical products; by installing these tags inside the products, we are able to identify any product at any time. Because these RFID tags are distinct and challenging to replace, we can quickly distinguish between identical and duplicate products by just scanning their RFIDs. RFID tags can be useful for monitoring product details. . For instance, it would be simple to spot fake drugs if all medical records were posted in a public medical database that allowed hospitals and patients to view the tags on their prescription drugs and equipment. By affixing an RFID tag to the medications, IoT may also be used to track them in real time. Hospital employees can use these tags to find and gather related information about medications, such as name, batch, origin, delivery, and storage. These details aid in locating outdated and subpar medications.

* 1. **Medical information management**

Hospital information management systems, which primarily involve sample, patient, or doctor identification, medical equipment, and medical record identification, have become the de facto language of the day. Medical history, examination results, treatment records, and other facts are examples of patient information. These aid the physician in creating a treatment plan. It prevents intravenous injections and the use of incorrect medications. When a doctor has to treat several patients at once in an emergency, medical reports from two different patients may be exchanged, which could mislead clinicians and result in inappropriate treatment. Therefore, hospitals can employ RFID technology to swiftly verify patient identities and medical examination data in order to prevent this scenario.

RFID tags will streamline manual and paper records of storage, and IoT can help manage the storage of medications. It can be used to prevent confusion over the names, formulas, and dosages of medications. In order to save time during identification and the creation of examination reports, RFID tags can be used in blood information management. [19]

A diagram of a computer network

Description automatically generated

Figure 2. IoT embedded in Health Management System

* 1. **Telemedicine**

The goal of telemedicine, a new type of medical service that combines computer, communication, medical, and multimedia technology, is to improve diagnosis and medical support, lower health care costs, meet people's medical needs, and create a patient-centered service system that allows for ongoing monitoring of critically ill patients. Progressive sensors may now effectively connect with one another to create a body sensor network for the patient thanks to advancements in remote technology. In addition to offering life-saving information, telemedicine monitoring has been progressively concentrating on enhancing people's quality of life [20].

* 1. **Mobile medical care**

Only portable medical devices that can easily connect wirelessly to internet-access devices, such as a computer, server, or cell phone, are used in mobile medical and health care. As seen in Figure 2, these mobile devices use Bluetooth, Wi-Fi, and Zigbee technologies to gather medical data from the human body and send the data stream over the internet. These data streams arrive at medical facilities and research institutes via the internet, where they are initially examined. If the data analysis reveals an illness, the information is then forwarded to a specialist level for additional medicine.

1. **IoT in mining industry:**

Whether a country is underdeveloped, developing, or developed, the mining industry makes a significant contribution to its economy. The mining industry accounts for 90% [21] of the GDP of many Middle Eastern and African nations. The industry places a high priority on worker and mining equipment safety because any danger in the field might result in hundreds of fatalities and millions of dollars in losses. These days, the mining environment is more complex due to the rise in modern equipment, the typical mining environment, and geological obstacles. Perfect coordination at the highest levels of equipment management and maintenance is required to address this issue and support mining operations. Figure depicts the flow of activities in mining cycle.



Figure 3. Flow graph of mining cycle.

*3.1. Search for Ore*

Initial stage involves identification of deposits and other important minerals inside earth, which may require direct or indirect exploration.

*3.2. Exploration*

This stage comprises of exploring of site for feasibility and quality of sample being excavated, techniques involve scientific approach.

*3.3. Establishment*

This stage involves establishment of necessary infrastructure for the mining job.

*3.4. Exploitation*

This stage comprises of obtaining of ore and minerals from the excavation site in quality as well as quantity, though development of infrastructure may take be done as per feasibility and expected recovery.

*3.5. Reclamation*

Final stage of the process involves Shutting of mine and restoring of the natural habitat as it was before the process. Planning engineers should time line the series of events so that the process of change is smooth.

Whether in a prosperous or underdeveloped country, the mining industry makes a significant contribution to the economy. 90% [21] of the GDP of the majority of Middle Eastern and African nations comes from the mining sector. When a danger arises in the mining area, it costs the company millions of dollars and hundreds of lives. Therefore, worker and equipment safety are crucial issues for the industry. The mining environment is more complicated these days due to the rise in contemporary equipment, the usual mining environment, and geological difficulties. We require complete coordination at the highest levels of equipment management and maintenance to support mining operations in order to resolve this issue. [23, 24]

The description and status of the equipment are described by real-time data in the Integrated Control and Monitoring system. These data are easily comprehensible by staff, who can utilize them to identify inactive equipment, calibrate maintenance cycles, and ensure equipment life. These data streams also preserve information in a data collecting center for later use; in the event of an accident, this information aids personnel in determining the reason and addressing any gaps in safety and security procedures. The Integrated Control Monitoring System has the following features:

1. The data supplied by the equipment manufacturer must first be stored in this system.
2. Under the guidance of engineers in the mining area, it records data from equipment when it is initially installed.
3. For monitoring purposes, an Internet of Things system continuously gathers real-time data from all of my operational equipment.   
   iv. The system will determine the life and maintenance duration of each piece of equipment based on both real-time and pre-stored data [25].
4. This system lessens human intervention to cut down on errors, which can occasionally result in danger.
5. This system automatically creates maintenance records and aids management in forecasting industry maintenance and operating costs for the upcoming year [26].
6. **IoT in transportation:**

The logistics of transporting people and goods between cities and towns have been totally transformed by smart mobility. Modern technologies such as the Internet of Things (IoT), artificial intelligence (AI), data analytics, and networking are used in "smart" transportation to enhance many aspects of our transportation networks.

IoT advantages In many respects, the logistic industry finds a natural fit with the Internet of Things because millions of goods must be transported daily by machines, cars, and humans. Every asset in the logistics sector is connected by this technology, which also analyzes data to maximize industry resources. Many handheld scanners and numerous sensors that can monitor cargo in warehouses and delivery trucks will be introduced by IoT technology in the business. These technologies' real-time monitoring, analysis, and decision-making capabilities enable this ecosystem of interconnected automobiles, infrastructure, and customers. Smart transportation systems may significantly increase productivity as gap for response time increases . Intelligent technologies can reduce congestion, enhance traffic flow, and minimize travel times through a variety of means, including predictive analytics, adaptive traffic light controls, and real-time route guidance. As a result, productivity increases, fuel prices decrease, and greenhouse gas emissions decrease. Figure 4 depicts the applications that are directly related to smart transportation system.



Figure 4. Applications related to smart transportation system

1. Route Optimization

City traffic often suffers from congestion, which is only going alarming level as number of vehicles are increasing steadily. To reduce traffic congestion, route optimization suggests alternate route for destination, this reduces travel time and harmful emission decreases.

1. Parking

Parking spaces can be felicitated with help of IoT assisted technologies for hunting parking lots to search available places in advance helps lessen traffic and pollution.

1. Lights

Smart Street Lights forms an important element of cities under smart domain, this can save energy while assisting dynamic management of traffic.

1. Controlled Junction and Traffic Lights

A controlled junction employs traffic signal to manage entry of vehicles depending on congestion level to smooth out movement. The scheme avoids jam on roads and a network of sensors is used to accumulate traffic data.

1. Accident Detection

Network of sensors is employed to keep track of activities on road especially congestion, maintenance and accidents. Each situation is delt with different procedure. Preventive measures can be established with the help of sensors to avoid undue casualties.

1. Road Anomalies

As the conditions of road immediately impacts movement on roads, anomalies in condition play a vital role in transportation efficiency, anomalies include potholes, bumps, and cracks, same may be alerted to drivers to avoid traffic congestion, car damage, and road accidents.

1. Infrastructure

Efficient utilization and efficiency of the support system depend a lot on infrastructure support as required by the IoT technology. The capabilities of smart transportation systems can be significantly increased by changing their infrastructure. [28]

* 1. **IoT in warehouse**

A warehouse is a key location in the supply chain for goods. Due to the current competitive environment, only logistics companies who provide their clients quick delivery, cost effectiveness, and greater warehouse flexibility will be able to thrive. It is a difficult task. Every section of the warehouse should be optimized to guarantee quicker product retrieval, processing, and delivery because there are thousands of different kinds and sorts of goods kept there. RFID tagging can offer an inexpensive, Internet of Things-powered identifying system in the warehouse. The wireless reader sensors (RFID readers) that collect transmitted data from every box that enters through the gate will be connected to the warehouse management system (WMS) [27].

Time-consuming tasks like manual counting and volume scanning of goods will be eliminated as a result. By detecting flaws in the dimensions and volume of the items, the camera mounted on the gate can also be used to identify damage. Additionally, WMS may offer real-time data for inventory management, avoiding scenarios like stock outs. The WMS sensors gather information and notify the warehouse manager if an item is ever lost. The sensors keep an eye on the products' environmental conditions and notify the WMS of any changes in temperature or humidity in order to preserve the quality of the goods. WMS notifies the warehouse manager after comparing the data with the threshold value determined for each commodity. Additionally, WMS links the machines that load and unload cargo; if any of these units become overly busy or idle, the work is automatically distributed appropriately.

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* 1. **IoT in Flight transportation**

Any shipment or cargo container in the middle of the Pacific Ocean can now be tracked. However, there is a delay in providing cargo container inside information. Because it delays inventory and raises the cost of stolen products, this costs businesses billions of dollars annually. IoT-based location and condition tracking can raise the visibility and security of transportation to a new level. By using sensors within the vehicle and many sensor tags inside the item, it provides clear view of the items meter by meter and second by second. It also continuously transmits data on location and detects potential theft by determining whether the box has been opened.The cargo's real-time location is gathered and transmitted using GPS and GPRS devices. Additionally, the GPRS module links to additional sensors that continuously send data that may be examined at the company's base station. The care vehicles' safety and well-being may be tracked with IoT. If an issue arises with the car, it notifies the driver and the business, enabling management to respond promptly and precisely. The Internet of Things creates opportunities for asset and fleet management. The truck and container's sensors continuously check on their operation. [29]

1. **Conclusion**

The Internet of Things (IoT) has enormous potential for use in the mining, transportation, and health care sectors. It can assist hospitals in implementing intelligent health treatment and management systems, which include gathering, storing, managing, sending, and exchanging medial information such as medication, equipment, and patient data within the hospital. IoT can develop a mining equipment management system based on IT and IoT technologies that can provide efficient electromechanical equipment monitoring, maintenance, and assessment in the mine. By improving the safety, intelligence, and flexibility of their services, IoT can be integrated into the transportation sector. The work presented offers a thorough examination of the relationship between the Internet of Things (IoT) and healthcare, mining and transportation industry, highlighting the revolutionary potential of this technology for the the said fields. To summarize the creation of IoT-enabled healthcare systems includes sophisticated data processing and large data storage capacities. this integration has been further felicitated by the integration of wireless sensor networks (WSNs) and the Internet of Things (IoT). The mining industry has a diverse setup, and because of infrastructure restrictions in communication, data management, storage, and information exchange, it might be challenging to identify areas where sensor-assisted IoT technology can be useful. The majority of research efforts to date on applying IoT in the mining industry concentrate on specific issues like ventilation monitoring, accident analysis, fleet and personnel management, tailing dam monitoring, and pre-alarm systems. In the automobile industry, integration of WSN within vehicles can be employed to harness sensor details for smart navigation, quick response, vehicle maintenance and interactive ambience. The logistics of transporting people and goods between cities and towns have been totally transformed by smart mobility.

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1.

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3.

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