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Automation Designed for Industry 4.0 Using Robotics and Sensors that Based on IoT & Machine Learning

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Abstract: The adoption of Industry 4.0 is anticipated to enhance multiple facets of human existence. The integration of Industry 4.0 will influence various stages of production processes, distribution networks, consumers, supervisors, creators of digital systems, and all staff members engaged in the process. This will lead to changes in manufacturing models and business patterns. This technology enables self-identification, self-configuration, self-diagnosis, and self-optimization in different industries. This study explains the decision tree algorithm to monitor the energy usage of machines and appliances, predict their future actions. Upon assessment of the effectiveness of the proposed system and comparing it against current methodologies, it was determined that the system had a sufficient efficiency rate. The integration of this technology presents a number of obstacles, such as standardization dilemmas, security risks, difficulties with resource planning, legal considerations, and the necessity of adjusting to evolving business models. The success or failure of Industry 4.0 and its implementation relies entirely on the involvement and cooperation of all participants in the production chain, from manufacturers to end-users.

Keywords: Robotics, Sensors, Artificial Intelligence (AI) and the Internet of Things (IoT)

I. INTRODUCTION

The emergence of Artificial Intelligence (AI) has led to a substantial shift in contemporary civilization, offering a valuable contribution to humanity through science and technology. This relatively new technology has been employed in diverse areas and has enhanced the quality of life [1]. Industry 4.0, which is alternatively referred to as the fourth industrial revolution, began at the dawn of the 21st century. It involves the integration of advanced production and operation methods with digital technology [2]. Cutting-edge technologies such as AI, robotics, quantum computing, additive manufacturing, and the Internet of Things (IoT) are utilized to merge smart and connected technologies into businesses, resources, and personal devices [3]. Collectively referred to as the Fourth Industrial Revolution (4IR), the current era of the internet, advanced analytics, automation, and other advanced technologies have been modernizing global commerce for several years. Machine learning is an evolving technique that enables computers to automatically learn from available data [4]. By utilizing various methods, it creates mathematical models and generates predictions based on data analysis [5]. This study investigates the utilization of Internet of Things (IoT) and machine learning in the upcoming era. IoT is a concept that entails an assemblage of tangible objects that are embedded with sensors, software, and other technologies. These objects are interconnected to transmit data to other systems and devices through the internet. Robotics is an engineering field that is focused on the development, design, production, and utilization of robots [6]. The primary objective of this field is to create intelligent machines that can assist humans in a variety of ways. Robots are automated industrial machines that are capable of performing multiple functions and can be reprogrammed to perform difficult tasks in place of humans. When a sensor is referred to as an "input device," it means that it is a constituent part of a larger system that provides input to a central control system [7]. Sensors enable various devices and systems to connect with one another and facilitate interaction among different units in order to monitor systems and equipment at each location. With the advent of the Internet of Things (IoT), conventional sensors have transformed into intelligent sensors, allowing sophisticated calculations to be conducted location within a sensor module

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using measured data [8]. This paper seeks to offer a comprehensive understanding of how machine learning techniques interface with Industry 4.0 by utilizing robotics and sensors.

II. LITERATURE SURVEY

Organizations strive to increase efficiency by integrating machines and human capabilities. In the present business landscape, the drive for competitiveness is constantly increasing [14]. The recent progress in technologies like radio frequency identification (RFID), smart sensors, 3D printing, the Internet of Things (IoT), robotics, and automation has resulted in noteworthy modifications in multiple areas of all industries. These changes encompass transportation and logistics, consumption, product transformation, and business models [15]. Intelligent systems are becoming increasingly necessary to make timely and informed decisions. In recent times, particular functions in manufacturing processes, such as the painting of car doors and the assembly of parts, have been delegated to robots and machines. The incorporation of robots in the manufacturing sector is noteworthy as they execute tasks intelligently and effectively, while also amplifying cooperation, flexibility, and safety [16]. The field of collaborative robots is a result of progress in AI and ML software, which builds on the foundation of traditional industrial robotics [17]. In addition, the Autodesk tool is employed to expedite the design and production of drones, leading to quicker delivery of the final product to customers. The field of robotics encompasses various capabilities and technology domains, requiring the integration of devices, robots, and sensors, sometimes with the assistance of third-party web services [18]. The expansion of Industry 4.0, robotics technology, and manufacturing is currently taking place at a swift pace. The objective of Industry 4.0 robotics is to create an intelligent industry that employs technologies such as IoT to generate alternate routes during interruptions and empower products to manoeuvre through the production process autonomously [19]. The purpose of this article is to emphasize the notable changes that have taken place from the first industrial revolution (Industry 1.0) to the present Industry 4.0. The expedition began in the 18th century with the innovation of the steam engine, succeeded by the second industrial revolution in the 19th century with the implementation of electricity, and the third industrial revolution in the 20th century with the ubiquitous use of computers. The amalgamation of cutting-edge technologies like big data, IoT, and robotics defines Industry 4.0, which is the quintessence of the fourth industrial revolution. The Web of Things (WoT) is an extension of IoT that emerges when internet-connected data and services are linked to sensors and actuators. In IoT settings, a diverse range of services is typically provided by the internet [20].

III. METHODOLOGY APPROACH

The manufacturing process and implementation of Industry 4.0 applications are depicted in Figure 2. It is evident that risk, flexibility, quality, and technology are critical factors in any manufacturing process. Incorporating mobile communication devices into industrial environments through the integration of manufacturing processes is a common practice in commercial innovation. This enables easy access to information at any time and place. This approach provides an efficient method for keeping up with the latest advancements and interconnectivity in technology, thereby eliminating gaps between the base and control and fostering a collaborative environment to achieve the best solution. To achieve the desired end product, To fulfil an organization's needs, it is crucial to streamline available resources, comprising of manufacturing procedures and personnel. A method for integrating Industry 4.0 utilizing Artificial Intelligence (AI) and the Internet of Things (IoT), alongside an exemplary graph, is presented below: \succ The primary step is to gather data from multiple sources, such as sensors, robots, and manufacturing lines. Temperature, pressure, speed, and other characteristics are examples of such data. \succ Once the data has been gathered, it must be evaluated in order to given valuable insights. AI techniques such as machine learning used to do this revolution of industry 4.0. \succ The analysed data can be applied to build predictive models that can predict equipment breakdowns, improve production schedules, and detect quality flaws. \succ The forecasting can be applied to monitor the manufacturing process in real time, identifying irregularity and informing operators to possible problems. Robots can make decisions automatically using AI, depending on data collected and analysed. This can lead to increased efficiency, decrease downtime, and improve quality. > Though machines can make autonomous decisions, human operators continue to play an important part in the production process. Collaboration between people and robots can produce improved

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results. The final phase is to use data analytics and input from the manufacturing process to continuously improve the manufacturing process.



Fig. 2. Pillars of "Industry 4.0"

IV. DISCUSSION

Robotic technology is the core technology of Industry 4.0, as evidenced by the number of patent applications in robotics 26% in 2016 worldwide Fig. 3. The trend of implementation of industrial robots in the world is growing Fig. 5.- Fig.7., and the lead by 2022 is that the implementation of robots will be a growing trend. In the metal industry is also a growing trend Fig. 8. and Fig. 9., and the reason is the implementation of industrial robots in the service of CNC machines, as well as the implementation of service robots for logistics in production processes in the metal industry. With the implementation of Industry 4.0, the trend of robot implementation in the metal industry will be growing. With the development of robotic technology in implementation are second-generation industrial robots collaborative robots and service robots for logistics that are fully intelligent.

V. CONCLUSION

The proposed approach involves utilizing a machine learning method called decision tree to examine IoT smart meters. By employing this decision-making process that relies on data and insights, the advent of Industry 4.0 has opened up numerous possibilities in the manufacturing industry. The decision tree approach was utilized to distinguish between real and fake data categories by analysing smart meter readings. Upon evaluation and comparison with existing methodologies, it has been concluded that the proposed system operates with an efficiency of 79%. The implementation of this methodology increases the reliability of smart IoT systems in industries, resulting in better investments for Industry 4.0. Additionally, this approach has the potential to be extended to a variety of machines and sensors in the future.

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