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IoT Based Welding Fume Extraction Machine

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ABSTRACT: The IoT-based welding fume extraction machine is a technological solution that can be applied in various industries and settings where welding activities take place. This machine utilizes IoT technology to monitor and control fume levels in real-time, ensuring a safe working environment for workers. These at construction sites, the machine can be deployed to remove harmful fumes generated during welding activities, protecting the health of workers. Abstract highlights some potential applications of the IoT-based fume extractionmachine. It can be deployed in manufacturing and fabrication facilities, construction sites, automotive repair and maintenance workshops, shipbuilding and offshore industries, as well as educational institutions and training centers. In manufacturing and fabrication facilities, the machine can effectively monitor and control fume levels in real-time, ensuring a safe working environment for workers operating multiple welding stations simultaneously. In automotive repair and maintenance workshops, the machine can ensure that fumes generated during welding operations are properly extracted, preventing health risks for mechanics and other workers.

KEYWORDS: Fume Extractor, Filters, Contaminants, Welding Fumes, Emission, Natural Ventilation.

I.INTRODUCTION

An IoT-based welding fume extraction machine is a cutting-edge device that utilizes Internet of Things (IoT) technology to revolutionize the process of extracting welding fumes in a welding environment. By incorporating advanced sensors, connectivity, and cloud-based platforms, this machine offers enhanced safety, real-time monitoring, remote control capabilities, and data-driven insights. One of the key components of this machine is itsarray of sensors. These sensors include smoke or fume sensors, temperature sensors, air quality sensors, and humidity sensors. By continuously monitoring the welding environment, these sensors collect vital data on fume levels, temperature, air quality, and humidity. Connectivity is another crucial feature of an IoT-based welding fumeextraction machine. By being connected to the internet, this machine can transmit the collected data to a cloud-basedplatform or a central monitoring system. This connectivity enables real-time monitoring and remote control capabilities, allowing users to monitor the welding environment from anywhere and at any time. The collected datais sent to a cloud-based platform where it is processed and analyzed. This platform provides valuable insights into fume levels, air quality, and other parameters. Users can make informed decisions regarding ventilation and occupational safety based on this information. Remote monitoring and control are made possible through a web or mobile application. Users can access real-time data, receive alerts or notifications when certain thresholds are exceeded, and adjust the extraction settings accordingly. This remote control capability offers convenience and flexibility in managing the welding environment. Automation is a key aspect of an IoT-based welding fume extraction machine. Based on the collected data and user-defined settings, the machine can automatically adjust theextraction system's speed or intensity to maintain optimal air quality and remove harmful fumes. This automation ensures efficiency and effectiveness in fume extraction. In the ever-evolving landscape of industry and technology, innovation is the driving force behind progress. The IoT-based Welding Fume Extraction Machine represents a powerful synergy of cutting-edge technology and a fundamental industrial need. Welding, a pillar of manufacturingand construction, plays a pivotal role in shaping the world around us. However, it has long grappled with a hidden challenge the emission of hazardous welding fumes. This presentation embarks on a journey into a new era of welding safety and environmental responsibility. We introduce the IoT-based Welding Fume Extraction Machine, a revolutionary concept that marries the Internet of Things (IoT) with a critical industrial process. Our exploration will reveal how this amalgamation is set to transform the landscape of occupational safety, workplace efficiency, and environmental compliance.

Welding, a process that joins materials through fusion, has a rich history dating to ancient civilizations.Over the centuries, advancements in welding techniques have shaped industries and contributed to various technological developments. However, it is crucial to address the potential health hazards associated with welding fumes, which can have serious implications for workers' well-being. The practice of joining similar metals dates back thousands of years, known as

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forge welding during the Bronze Age. Notably, the construction of the 5.4 metric-ton iron pillar in India in 310 AD stands as a remarkable example of early welding techniques. During the Middle Ages, blacksmiths refined forge welding by repeatedly pounding heated metals until they achieved a strong bond. The advent of World War I brought about a surge in welding processes, as military powers sought to determine the most effective techniques. Substantial advancements occurred in the 1920s, particularly in shielding gas welding, which aimed to protect welds from the detrimental effects of oxygen and nitrogen in the atmosphere. Eventually, in 1942, the Gas Tungsten-Arc Welding (GTAW or TIG) process, licensed to develop by the Linde Company, revolutionized welding practices. The utilization of aluminum and magnesium skyrocketed due to GTAW's development. While welding enables remarkable possibilities, it also poses health risks, primarily through the inhalation of welding fumes. These fumes, combined with grinding dust, can be detrimental to the well-being of welders, trainee welders, and others in the welding environment. One notably hazardous fume, hexavalent chromium, is produced during the welding of stainless steel and chromium-containing materials. Oxidation convertschromium into hexavalent chromium, also known as Chromium VI or Cr (IV), which is classified as a carcinogen.Other harmful elements, like manganese, may also be present in welding fumes. To mitigate the health risks associated with welding fumes, regulatory bodies such as the Occupational Safety and Health Administration (OSHA) enforce strict guidelines. According to OSHA regulations, employers must assess worker exposure to hexavalent chromium on an 8-hour time-weighted average basis. Monitoring of welding environments is required every six months if the fumes exceed 50% of the Permissible Exposure Level (PEL).

II. LITERATURE SURVEY

Els, L, Coetzee, C., and Vorster, O. 2017, Latest Mn and psychiatric disease issues reinvigorated attempts to regulate lower rates of welding gases. The primary engineering regulation for external hoods equipped to regulate welding fume is Local Exhaust Ventilation, and design standards are in place, which work minimum velocities within the range of 0.50 to 0.87ms.

C.B. Solnordal, P.J. Witt, A. Manzoori, H. Namavari E. Niknejad. M. Davari, the operative engineering measures during the implementation of welding fumes in the automotive industries by recording different level of efficiency of Local exhaust ventilation either in construction field or in different manufacturing industries.

H. Mekky. A. Mohaisen, an d Z.-L. Zhang . The study registered an 1824 fpm (927 m s) hoodface velocity in Unit 2 hood face core and decided the airflow was 391 cfm (0.19 m's) .The catch velocities calculated 312, 224 and 53 fpm (1.4. 1.3 and 0.24 ms). The measures of immediate intake (total fume) suggested by Unit 2 were slightly higher than Unit 1 (P=0.04) and considerably superior than no ventilation at all (P=0.007), Unit 2 was slightly higher than almost no ventilation (P= 0.02) for CrVI .

III. NECESSITY

Welding is a widely used industrial process that generates hazardous fumes and particulate matter, posing serious health risks to workers. Prolonged exposure to welding fumes can lead to respiratory issues and welding-related lung diseases. In order to prioritize the well-being of workers, there is a strong need for an IoT-based welding fume extraction machine. This innovative system efficiently eliminates these harmful emissions, significantly reducing the risk of occupational health problems and creating a safer and healthier work environment. Employers have a legal obligation to protect their workers from exposure to harmful substances, including welding fumes, as mandated by occupational safety and health regulations. Failure to comply with these regulations can result in financial penalties and legal consequences. The adoption of an IoT based system is crucial as it enables businesses to not only meet but also exceed regulatory requirements. This helps them avoid legal liabilities and demonstrates a commitment to maintaining ethical workplace practices.

IV. FUTURE SCOPE

The future scope of welding fume extraction machine is promising, as the demand for such devices is expected to increase in various industries that involve welding processes. According to are port by Reports and Data, the market for welding fume extraction equipment is anticipated to expand throughout the course of the projected period with help from additional end-use sectors like shipbuilding, oil & gas, and metal fabrication. The report also states that the increased adoption of automated and robotic welding systems, the growing awareness of occupational health and safety, and the stringent regulations and standards for welding fume exposure are some of the key factors driving the market growth. The report forecasts that the global welding fume extraction equipment market size will reach USD 8,581.06 million by 2030, registering a compound annual growth rate (CAGR) of 5.8% from 2023 to 2030.Development of innovative products that offer higher efficiency, better filtration and ease of use. For example,

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Nederman offers a wide range of suction arms in different designs, such as telescopic ,spring-balanced, hose reel and fan. These arms can be easily positioned and adjusted to capture vapors at the source. Integrating smart technologies such as sensors, IoT and cloud computing for remote and real-time monitoring and control of welding fume extraction equipment. This can help optimize performance, reduce energy consumption and improve equipment maintenance. Market expansion in emerging regions such as Asia Pacific, Latin America and the Middle East and Africa, where industrialization and urbanization are growing rapidly. These regions offer welding fume extraction equipment manufacturers potential opportunities to penetrate new markets and customers. Adopting green and sustainable practices to reduce the environmental impact of welding fumes. This may include using renewable energy sources, recycling or reusing filters and minimizing waste production. Welding, a fundamental industrial process, has shaped the modern world, joining metals together for construction, automotive, aerospace and manufacturing. But this vital technique comes with a hidden threat: the creation of dangerous fumes and solid particles. The health risks posed by welding fumes, including respiratory problems, cancer, and eye and skin irritation, are a growing concern. To address these challenges, welding fume extraction machines have proven to be a critical tool for protecting the welfare of welders and the environment. Ongoing research is improving filter technology to increase their efficiency and lifespan. On the horizon, nanotechnology is poised to create filters with finer pores capable of capturing even smaller particles and impurities. These improvements promise to provide cleaner air for welders and the surrounding environment. The global interest in energy saving extends to welding fume extraction systems.

V. SYSTEM MODEL AND ASSUMPTIONS

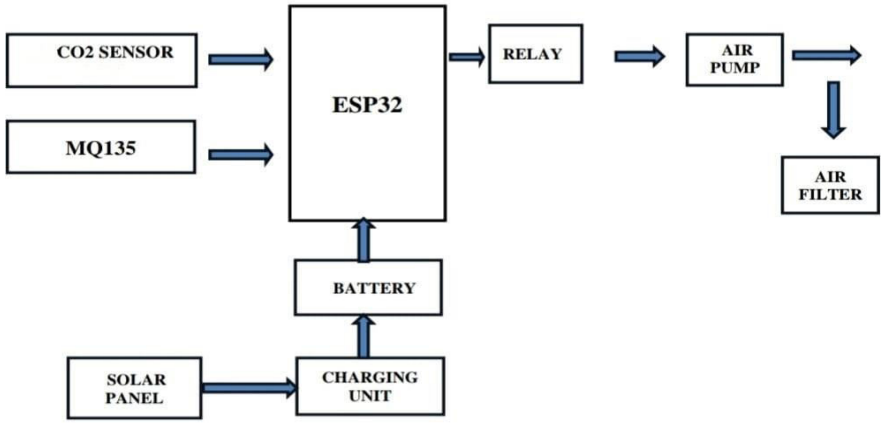

Fig.1.BlockDiagram of Welding Fume Extraction Machine

The block diagram provided illustrates the functional components and interactions within an IoT-based welding fume extraction device. This advanced system is designed to ensure the safety of workers in the welding environment by effectively monitoring and controlling air quality. At the heart of the system is a "microcontroller," a central processing unit like an Arduino that acts as the brains of the operation. It is responsible for orchestrating various tasks and managing communication between various components. The microcontroller communicates with "Air Quality & Flow Sensors", specialized devices that measure the concentration of solid particles and gases in the air. These sensors continuously collect data and provide a real-time overview of the air quality in the welding area. The collected data is then processed by the "Sensor Data Processing" module. This component analyzes the sensor data, interprets the air quality status and generates actionable information. If the air quality exceeds pre-set thresholds, an “Alert System” comes into play, sending alerts to users through a “User Interface” which can be a web or mobile application. This ensures that workers and supervisors are immediately informed of any hazardous conditions, allowing for quick intervention. In addition, the microcontroller works with the "Motor/Blower & Actuators" section. This part is responsible for regulating the extraction process. Based on the processed sensor data, the control system adjusts the extraction speed by controlling the engine or blower speed. "Exhaust Control Logic" ensures that the exhaust system is operating optimally, effectively removing welding fumes while maintaining a safe and comfortable working environment. For remote monitoring and control, the microcontroller establishes a connection with the "Cloud Server". This server stores historical air quality and system performance data, allowing users to track trends and patterns over time. In addition, it provides a platform for users to remotely access the system through a user interface. Users can

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adjust extraction settings, view historical data, and receive real-time alerts, all from a remote location. Ultimately, this IoT-based welding fume extraction machine aims to increase workplace safety by continuously monitoring air quality, enabling remote management and automatically adjusting extraction processes based on real-time data. By integrating various components and technologies, this system contributes to a healthier and safer work environment for welders while facilitating efficient system operation and maintenance.

VI. RESULT AND DISCUSSION

- When we switch on the device the machine will be in off mode until MQ135 sensor sense the welding fume.


d

- When MQ135 sensor triggers the relay and pump starts sucking the surrounding fume inside the filterchamber and clean air is flown out from the filter chamber.

1. This proposed system gives a smart welding fume monitoring and filtration system that constantly keeps track of airquality in an surrounding area and displays the air quality measured on an mobile screen .

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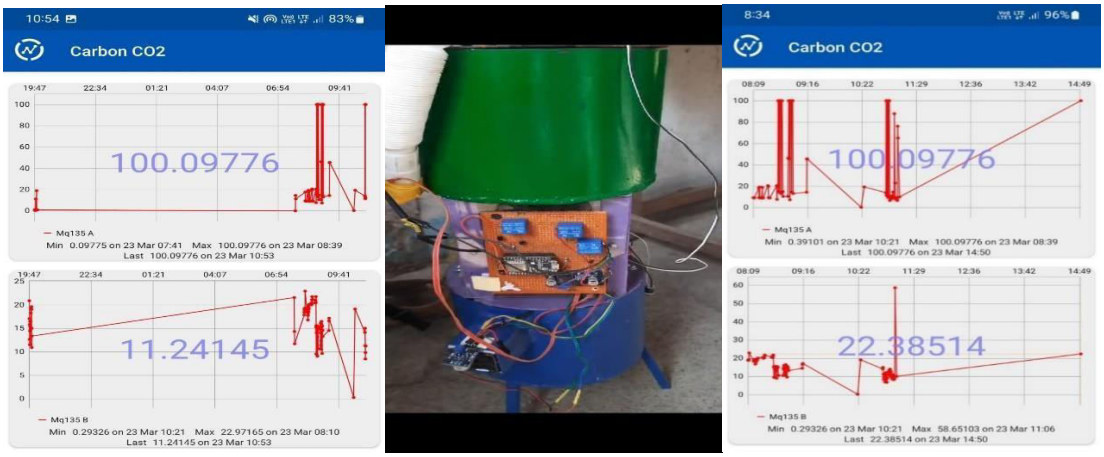

VII. CONCLUSION

A welding fume extraction device is a device that captures and removes harmful fumes and gases produced during welding processes. Welding fumes can cause a variety of health problems such as lung damage, cancer, metal fume fever, nervous system damage, eye irritation, skin burns and reproductive disorders. Therefore, it is important to use welding fume extraction equipment to protect workers and the environment from these hazards. A welding fume extraction machine works by using a fan and negative draft to draw fumes and solids into a filtration system. The filtration system can consist of different types of filters, such as pre-filters, main filters, HEPA filters, carbon filters, etc. Filters capture impurities and allow clean air to be recirculated or extracted. Some welding fume extraction machines also have features such as spark arrestors, fire suppression systems, automatic filter cleaning, etc.

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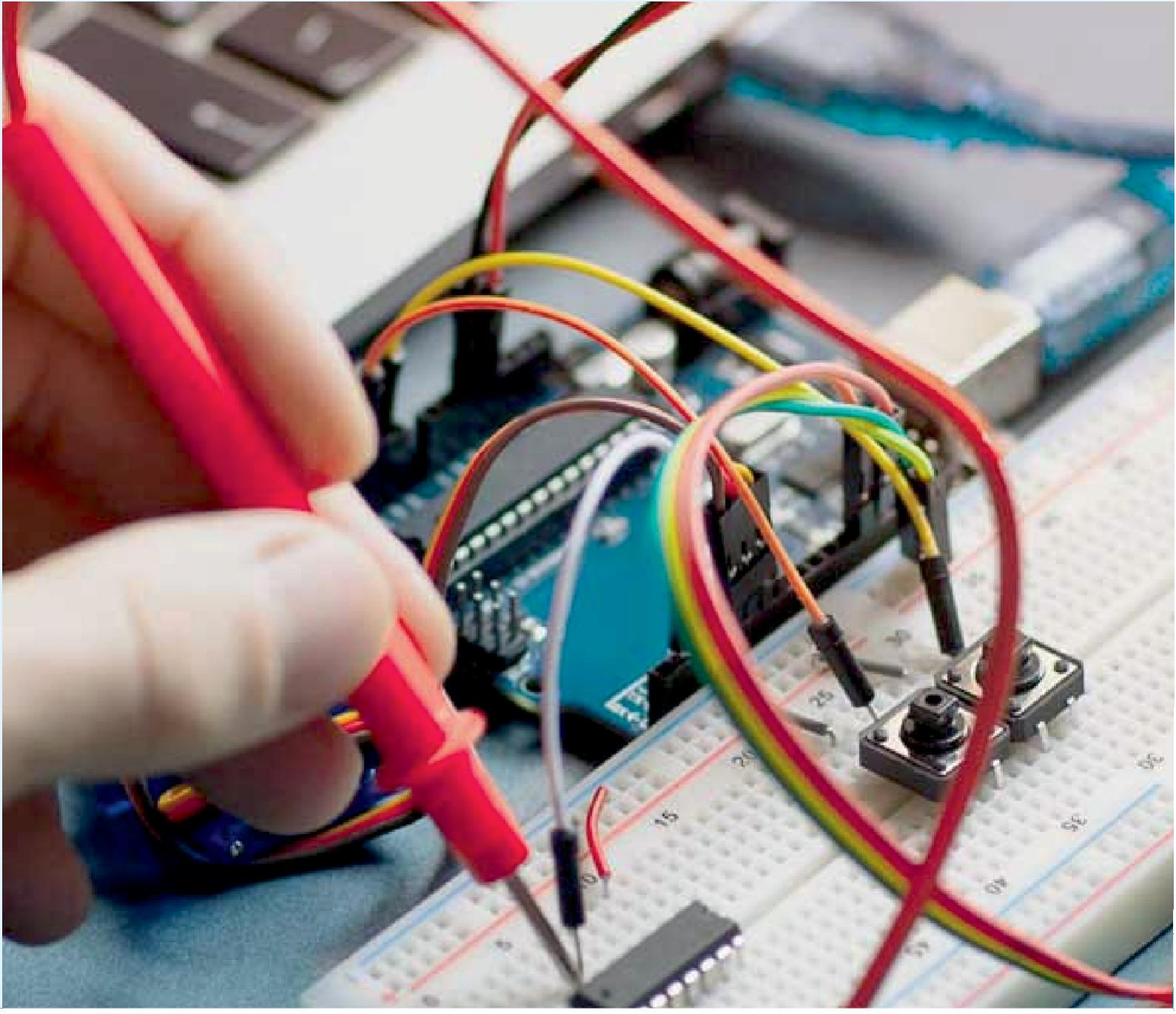
2. "Smart Welding Fume Extraction System for Welders' Safety" by B. S. Selvakumar, et al. This paper presents a smart welding fume extraction system that employs IoT technology for real-time monitoring and control. It highlights the importance of air quality and safety for welders, along with the benefits of data analytics for preventive maintenance.
3. "Design and Development of an IoT-Based Welding Fume Extractor" by V. Rajaram and R. Karthick This research work describes the design and development of an IoT-based welding fume extractor. It covers the hardware components, IoT integration, and the software used for monitoring and controlling the extraction system.
4. "Enhancing Welding Safety with IoT-Based Fume Extraction" by A. Gupta .This article provides an overview of the advantages of IoT-enabled welding fume extraction systems. It emphasizes worker safety, regulatory compliance, and the role of IoT in achieving these goals.
5. "IoT-Driven Welding Fume Extraction: A Roadmap for Future Research" by A. Khanna, et al. This forward-looking reference outlines a roadmap for future research in the field of IoT-based welding fume extraction. It identifies areas for innovation and the potential impact of emerging technologies.



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