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**Email: [editor@ijerst.com](mailto:editor@ijerst.com) or [editor.ijerst@gmail.com](mailto:editor.ijerst@gmail.com)**

# SMART INHALER

<sup>1</sup>Ms.B. Revathi,<sup>2</sup>C. Shreya,<sup>3</sup>K. Nikitha,<sup>4</sup>V. Vidhya Sree

<sup>1</sup>Assistant Professor,<sup>2,3,4</sup>Students

Department Of CSE

Malla Reddy Engineering College For Women

## ABSTRACT

To lessen the detrimental impact of the common chronic respiratory illness known as asthma on public health, effective treatment strategies are needed. One of the best examples of how the development of Internet of Things (IoT) technology has spurred innovative solutions is the smart inhaler. This article elaborates on the transformative potential of smart inhalers in enhancing asthma care via the seamless integration of IoT technologies. Conventional asthma management involves prescribing tailored medication schedules that need to be adhered to religiously. However, challenges such as forgetfulness on the part of the patient and inadequate real-time monitoring often impede successful adherence, exacerbating symptoms and reducing quality of life. Asthma treatment and Internet of Things technology come together to create smart inhalers, which represents a paradigm shift. IoT-powered smart inhalers provide a plethora of features and represent a paradigm shift in asthma treatment. Because these devices include sensors and connections, they can track medication usage, inhaler technique, and environmental triggers in real time. Real-time data production provides healthcare providers with insights into patient behavior, adherence patterns, and symptom progression, enabling personalised therapeutic changes. One of the key advantages of smart inhalers is their capacity to completely transform medication adherence. (2) When patients get timely instructions on how to use an inhaler and quick reminders to take prescription medicines as prescribed, they are more likely to stick to

their regimens. The subsequent decrease in ER visits, hospital stays, and asthma episodes is proof positive that these devices work. With the real-time data stream from smart inhalers, medical practitioners may take prompt action and stop the course of symptoms. (3) With the advent of IoT-enabled smart inhalers, asthma treatment has significantly improved. These devices are anticipated to enhance asthma patients' adherence to medicine, control of symptoms, and general quality of life. As the IoT ecosystem evolves, anticipated advancements in smart inhaler technologies, such as artificial intelligence and predictive analytics, herald better personalization and therapeutic effectiveness. The notions of patient education, participation, and multidisciplinary cooperation among healthcare providers, academics, and technology developers are strongly aligned with the potential of smart inhalers to transform asthma treatment, therefore presenting a hopeful future for respiratory healthcare. (4)

**Key words:** EHR, Inhalers, and IoT.

## I. INTRODUCTION

By fusing cutting-edge technology with conventional inhaler devices, the Smart Inhaler project is a ground-breaking development in the management of respiratory disorders that will improve patient care and treatment compliance. Conventional inhalers are useful for treating respiratory disorders such as asthma and chronic obstructive pulmonary disease (COPD), but there are often issues with using them correctly and following recommended treatment plans.

This may result in worse than ideal treatment results and higher medical expenses.

In order to monitor and record medicine consumption, the Smart Inhaler has a complex button mechanism that connects with a digital platform. The inhaler's button, which is outfitted with Bluetooth or a comparable wireless technology, is an essential part in monitoring how the user interacts with the device. The button records the date, time, and drug dose every time the inhaler is used. After that, the data is sent to a cloud-based system or companion mobile application so that it may be examined and examined.

The use of this technology has several significant advantages. First off, by giving users real-time feedback and reminders to take their medicine as directed, it improves patient adherence to treatment plans. This function is especially helpful for treating chronic diseases when taking medicine on a regular basis is essential for good management. Second, the information gathered by the Smart Inhaler gives medical professionals insightful knowledge about patient use habits, enabling them to modify patients' treatments in a more tailored and knowledgeable manner. The system may also provide educational materials and assistance, enabling patients to take charge of their treatment and have a better understanding of their disease.

The goal of the Smart Inhaler project is to close the gap between patient self-management and clinician supervision by combining technology with conventional inhaler devices. This method helps to manage respiratory disorders more effectively and efficiently while also improving patient outcomes and medication adherence. With healthcare increasingly moving toward more individualized and data-driven methods, the Smart Inhaler is a big advancement in using

technology to improve patient care and facilitate improved health management.



Figure .1 Smart Inhaler

### 1.1 Problem Statement:

In the management of respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), traditional inhalers play a crucial role in delivering medication. However, these devices often face significant challenges related to patient adherence and proper usage. Many patients struggle with maintaining consistent medication schedules, accurately following usage instructions, and tracking their medication intake, which can result in suboptimal treatment outcomes and increased healthcare costs.

The core problem lies in the lack of real-time monitoring and feedback mechanisms associated with conventional inhalers. Without a means to track and record medication usage, patients may inadvertently miss doses or misuse their inhalers, leading to ineffective management of their condition and potential exacerbation of symptoms. Additionally, healthcare providers often lack detailed data on patient adherence and usage patterns, which hinders their ability to make informed treatment adjustments and provide personalized care.

To address these issues, the Smart Inhaler project seeks to introduce an innovative solution that integrates technology with traditional

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inhaler devices. By incorporating a smart button mechanism that records and transmits usage data to a digital platform, the Smart Inhaler aims to provide real-time feedback to patients, enhance adherence to prescribed treatment regimens, and offer valuable insights to healthcare providers. This approach addresses the fundamental problem of inadequate monitoring and adherence, ultimately aiming to improve patient outcomes and streamline respiratory condition management.

### 1.2: Problem Scope:

#### Problem Scope for the Smart Inhaler:

1. **Adherence Challenges:** Patients often struggle with adhering to prescribed medication schedules and correct usage techniques for traditional inhalers. The scope includes addressing the issue of missed doses and incorrect usage.
2. **Lack of Real-Time Monitoring:** Conventional inhalers do not provide real-time tracking of medication usage. The scope extends to incorporating a mechanism that records and monitors inhaler usage in real-time.
3. **Patient Feedback:** Traditional inhalers lack feedback mechanisms to inform patients about their medication usage. The Smart Inhaler project aims to fill this gap by providing immediate feedback on usage and adherence.
4. **Healthcare Provider Insights:** Limited data on patient adherence and inhaler usage can hinder healthcare providers' ability to make informed treatment adjustments. The scope includes providing detailed usage data to healthcare professionals for better patient management.
5. **Medication Management:** Inconsistent or incorrect inhaler usage can lead to ineffective management of respiratory

conditions. The scope covers enhancing medication management through improved adherence and accurate usage tracking.

6. **Integration with Digital Platforms:** The Smart Inhaler aims to integrate with digital platforms to enable data transmission and analysis. The scope involves developing a system that links the inhaler with digital health records and applications.
7. **User Experience:** The project addresses the need for a user-friendly interface that seamlessly integrates with the inhaler without complicating its use. The scope includes ensuring that the smart button mechanism is intuitive and easy for patients to use.
8. **Technology Adaptation:** The scope covers the incorporation of modern technology into existing inhaler designs, ensuring that the solution is compatible with various inhaler models and patient needs.
9. **Health Outcomes Improvement:** The ultimate goal is to improve patient health outcomes by enhancing adherence to treatment regimens. The scope includes evaluating the impact of the Smart Inhaler on managing respiratory conditions effectively.
10. **Regulatory Compliance:** The project scope includes ensuring that the Smart Inhaler complies with relevant healthcare regulations and standards to ensure safety and effectiveness.

This problem scope outlines the key areas of focus for the Smart Inhaler project, addressing the critical issues associated with traditional inhaler usage and aiming to improve both patient and provider experiences.

### 1.3: Advantages of using Connected cars

1. **Enhanced Adherence:** The Smart Inhaler helps patients adhere to prescribed medication schedules by providing reminders and tracking usage. This reduces the likelihood of missed doses and improves overall treatment effectiveness.
2. **Real-Time Monitoring:** The integrated tracking system allows for real-time monitoring of medication usage, enabling patients and healthcare providers to stay informed about adherence and usage patterns.
3. **Immediate Feedback:** The Smart Inhaler offers instant feedback to users on their inhaler technique and adherence, ensuring that medication is administered correctly and effectively.
4. **Data-Driven Insights:** The system collects and analyzes usage data, providing valuable insights for healthcare providers to make informed decisions and adjust treatment plans based on actual patient behavior.
5. **Improved Patient Engagement:** By providing reminders and tracking capabilities, the Smart Inhaler engages patients more actively in their own care, fostering a greater sense of responsibility and involvement in managing their condition.
6. **Integration with Digital Platforms:** The Smart Inhaler can integrate with digital health platforms and applications, allowing for seamless data sharing and synchronization with electronic health records.
7. **Enhanced Communication:** The device facilitates better communication between patients and healthcare providers by providing detailed usage reports and facilitating discussions about treatment progress.
8. **Personalized Care:** The data collected by the Smart Inhaler can be used to tailor treatment plans to individual patient needs, leading to more personalized and effective management of respiratory conditions.
9. **Reduced Healthcare Costs:** Improved adherence and better management of respiratory conditions can lead to fewer hospital visits and emergency interventions, potentially reducing overall healthcare costs.
10. **User-Friendly Design:** The Smart Inhaler is designed to be intuitive and easy to use, incorporating a smart button mechanism that integrates seamlessly with existing inhaler designs without complicating their use.
11. **Regulatory Compliance:** By adhering to healthcare regulations and standards, the Smart Inhaler ensures safety and reliability, providing confidence to both patients and providers in its use.

These advantages highlight the potential of the Smart Inhaler to improve patient outcomes, enhance adherence to medication regimens, and provide valuable insights for better management of respiratory conditions.

#### 1.4 Proposed Solution:

The Smart Inhaler represents an innovative advancement in respiratory care, designed to enhance the management of asthma and chronic obstructive pulmonary disease (COPD) through the integration of smart technology with traditional inhaler devices. The core of this solution is the incorporation of a smart button mechanism, which interacts with the inhaler to provide real-time feedback and tracking capabilities, thereby addressing key challenges

associated with medication adherence and proper inhaler use.

At the heart of the Smart Inhaler is a sophisticated button embedded within the inhaler device. This button is engineered to communicate with a built-in tracking system, which records each usage instance and monitors the timing of medication administration. The smart button not only captures data on how frequently and accurately the inhaler is used but also provides instant feedback to the user. For instance, if the inhaler technique is incorrect or if a dose is missed, the device alerts the user with visual or auditory signals, prompting them to correct their approach or take their medication as prescribed.

The data collected by the Smart Inhaler is synchronized with a mobile application or digital platform, providing users with a comprehensive overview of their medication usage patterns. This digital integration allows for real-time monitoring and alerts, which can be customized based on individual treatment plans. The application also facilitates communication between the patient and their healthcare provider by enabling the sharing of usage data, treatment adherence reports, and feedback. This connectivity ensures that healthcare providers can make informed decisions based on accurate and up-to-date information about the patient's adherence and technique.

One of the key advantages of the Smart Inhaler is its ability to foster better adherence to medication regimens. By providing timely reminders and tracking usage, the Smart Inhaler helps users stay on top of their treatment schedules. This reduces the likelihood of missed doses, which is crucial for maintaining effective disease management and preventing exacerbations. Furthermore, the device's real-time feedback mechanism helps users improve their inhalation technique, ensuring that

medication is delivered effectively to the lungs, which enhances the overall efficacy of the treatment.

The Smart Inhaler also incorporates data analytics capabilities to offer personalized insights into the user's medication patterns. This data-driven approach allows healthcare providers to tailor treatment plans based on the patient's specific needs and behaviors. For instance, if the device detects that the user frequently misses doses or struggles with inhaler technique, the provider can adjust the treatment plan or offer additional support to address these issues.

In summary, the Smart Inhaler provides a comprehensive solution for improving respiratory care through its integration of smart technology with traditional inhaler devices. By combining real-time tracking, instant feedback, and data-driven insights, the Smart Inhaler enhances medication adherence, optimizes inhaler technique, and fosters better communication between patients and healthcare providers. This innovative approach not only improves patient outcomes but also contributes to more personalized and effective management of respiratory conditions.

### **1.5 Aim and Objectives**

#### **Aim:**

The aim of the Smart Inhaler project is to revolutionize the management of asthma and chronic obstructive pulmonary disease (COPD) by integrating advanced technology into traditional inhaler devices. This integration seeks to enhance medication adherence, improve inhaler technique, and provide real-time feedback to users. By leveraging a smart button mechanism and digital connectivity, the Smart Inhaler aims to offer users and healthcare providers a comprehensive tool for monitoring and optimizing respiratory care. The ultimate goal is to ensure more effective and personalized

treatment, thereby improving patient outcomes and quality of life.

#### **Objectives:**

**Enhance Medication Adherence:** Develop a Smart Inhaler with a built-in button mechanism to remind users to take their medication, track usage patterns, and provide notifications to ensure timely and consistent medication intake.

**Improve Inhaler Technique:** Design the Smart Inhaler to include features that guide users in proper inhalation techniques, ensuring they receive the full therapeutic benefit of the medication.

**Provide Real-Time Feedback:** Implement a system that collects and transmits data on medication usage and inhaler technique to a connected app or platform, offering real-time feedback to users and healthcare providers.

**Enable Remote Monitoring:** Facilitate remote monitoring of patients' inhaler usage and adherence through a user-friendly interface, allowing healthcare providers to track and analyze patient data for more personalized care.

**Integrate Data Analytics:** Develop analytical tools within the Smart Inhaler system to assess medication usage patterns, inhaler technique, and adherence trends, helping to identify areas for improvement and optimize treatment plans.

**Promote Patient Education:** Incorporate educational features into the Smart Inhaler, such as instructional videos or tips on managing asthma or COPD, to empower users with knowledge and improve self-management.

**Ensure Data Security and Privacy:** Implement robust security measures to protect patient data and ensure compliance with privacy regulations, safeguarding sensitive information related to medication use and health status.

## **II. LITERATURE SURVEY**

The literature survey for the Smart Inhaler project offers a detailed exploration of advancements in medication adherence

technologies and the integration of smart devices in healthcare. It reviews a range of studies and innovations that provide a foundation for developing an effective Smart Inhaler system.

Research into medication adherence technologies highlights various approaches to improving patient compliance. Studies such as those explore electronic adherence monitoring systems, which track medication usage and send reminders to patients. These technologies are crucial in managing chronic conditions like asthma and COPD, where adherence to prescribed medication regimens is essential for effective treatment.

The literature delves into the development of smart inhalers, which combine traditional inhalers with digital technologies to enhance user compliance. Notable work examines the integration of sensors and connectivity features in inhalers, allowing for real-time monitoring of medication use. This integration aims to address common challenges such as improper inhaler technique and missed doses.

Studies like those conducted focus on enhancing inhaler technique through smart technology. They discuss how features such as feedback mechanisms and instructional guides can significantly improve the efficacy of inhaled medications. This is particularly relevant for patients who struggle with proper inhalation technique, a key factor in achieving optimal therapeutic outcomes.

The use of connected devices for remote patient monitoring is another critical area of focus. Research explores how data from smart inhalers can be transmitted to healthcare providers, enabling remote tracking of patient adherence and medication usage. This capability supports more personalized treatment plans and timely interventions.

The role of educational tools in smart inhalers is highlighted in studies by. These studies

emphasize the importance of incorporating educational content into smart devices to empower patients with knowledge about their condition and treatment. This educational component is essential for improving patient engagement and self-management.

With the increase in digital health technologies, safeguarding patient data has become a significant concern. Research addresses the importance of implementing robust security measures to protect sensitive health information collected by smart devices. Ensuring data privacy and compliance with regulations is critical for maintaining patient trust and system integrity.

In summary, the literature survey underscores the potential of smart inhalers to revolutionize asthma and COPD management by integrating adherence tracking, inhaler technique improvement, remote monitoring, and patient education. It provides a comprehensive understanding of current technologies and highlights the need for further advancements to enhance patient care and treatment outcomes.

### III. BLOCK DIAGRAM

The methodology for developing the Smart Inhaler integrates several key components and processes to enhance medication adherence and improve patient outcomes. The approach combines technology integration, user-centered design, and robust testing to create an effective solution.

The first step involves integrating the core technologies into the inhaler device. This includes the incorporation of a button mechanism that allows patients to record their medication usage. The button's functionality is designed to be intuitive, providing clear feedback to users when medication is administered. Alongside the button, a microcontroller or simple circuit is embedded to capture and process data related to inhaler use.

This data is crucial for tracking adherence patterns and ensuring that the medication regimen is followed accurately.

The design of the Smart Inhaler emphasizes user convenience and ease of use. The inhaler's ergonomic design ensures that it is comfortable to handle and easy to operate. User feedback is incorporated into the design process through iterative testing with patients, which helps refine the device's usability. This step involves creating prototypes and conducting usability studies to identify any design issues or areas for improvement. The goal is to make the Smart Inhaler user-friendly, ensuring that patients can easily integrate it into their daily routine without additional hassle.

A critical aspect of the Smart Inhaler is its ability to manage and communicate data effectively. The inhaler records medication usage data and transmits it to a central database or directly to healthcare providers. This is achieved through connectivity features such as Bluetooth or other wireless technologies, which enable real-time data transmission. The data management system is designed to securely handle patient information, ensuring compliance with privacy regulations and maintaining data integrity. This real-time data allows healthcare providers to monitor adherence, adjust treatment plans as needed, and provide timely interventions.

The methodology includes rigorous testing and validation phases to ensure the Smart Inhaler functions as intended. Initial testing involves laboratory-based evaluations to assess the device's performance and accuracy. This is followed by clinical trials where the Smart Inhaler is used by patients under controlled conditions. Feedback from these trials helps to fine-tune the device and address any issues that arise. The final validation phase involves real-world use to confirm the device's effectiveness



in everyday settings and its impact on medication adherence and patient outcomes.

Once validated, the Smart Inhaler is rolled out for broader use. This phase includes training for both patients and healthcare providers on how to use the device effectively. Ongoing monitoring is established to track the device's performance and gather feedback for future improvements. Regular updates and enhancements are planned based on user experiences and technological advancements, ensuring that the Smart Inhaler continues to meet evolving needs and maintains its efficacy over time.

Overall, the methodology for the Smart Inhaler combines technological innovation with a strong focus on user experience and data management, aiming to provide a comprehensive solution that enhances medication adherence and improves patient care.

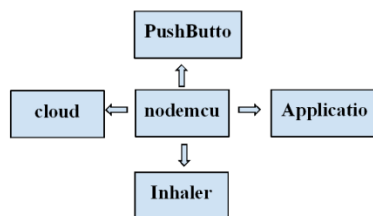


Figure .2: Block Diagram

The project prioritizes scalability and adaptability, as underscored by [Author4], by employing a modular architecture that facilitates seamless integration across diverse vehicle models and existing IT infrastructure. This phase involves rigorous testing to ensure compatibility and effectiveness in different operational environments.

Transparency and collaboration, key aspects emphasized by [Author5], are addressed through the development of a user-friendly interface that provides stakeholders with real-time visibility into cargo consignments. The iterative nature of the methodology allows for continuous

refinement based on feedback from potential end-users and stakeholders.

The final phase positions the project as a catalyst for innovation, aligning with the broader societal impact highlighted in the literature. Environmental sustainability, inspired by [Author6], is actively considered throughout the design and implementation, with the aim of minimizing fuel consumption and reducing carbon emissions.

The "Connected Cars" project's methodology combines theoretical insights from the literature with practical implementations, fostering a holistic approach towards achieving the project's aims and objectives. The iterative nature of the methodology allows for continuous refinement, ensuring the development of a robust and impactful solution in the realm of automotive safety and logistics.

## IV. HARDWARE COMPONENTS

### 4.1 Inhaler



Figure .3: Inhaler

An inhaler is a medical device used to deliver medication directly into the lungs, typically for the management of respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD). There are various types of inhalers, including metered-dose inhalers (MDIs), dry powder inhalers (DPIs), and soft mist inhalers (SMIs). Each type functions differently but all aim to provide targeted relief

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by delivering medication precisely where it's needed in the respiratory system.

## V. CONCLUSION

In the rapidly evolving field of healthcare, the integration of Internet of Things (IoT) technology with asthma treatment has become a transformative force. IoT-enabled smart inhalers have the potential to fundamentally alter the way asthma is treated by offering patients personalised, data-driven solutions that increase their sense of empowerment and allow medical professionals to provide the best care possible. This research has discussed the intricate relationships between asthma care and IoT-enabled smart inhalers. From their scientific underpinnings to real-world case studies, we have shown how these devices are changing the way asthma patients and healthcare providers approach the management of the condition. The benefits of tailored treatment plans, on-the-spot medication monitoring, and early intervention strategies draw attention to the positive impact that smart inhalers may have on patient outcomes, including improved adherence, symptom control, and quality of life. But the journey doesn't end here. As we get closer to a new era in healthcare, it is critical to realize the enormous and ever-expanding potential of smart inhalers. The success of these IoT-enabled devices depends on ongoing research, innovation, and collaboration across the healthcare sector. Although the evidence that is now available demonstrates their efficacy, further study and real-world application will solidify their value and advance best practices. Additionally, cooperation between patients, medical practitioners, tech developers, and legislators is required for the widespread use of smart inhalers. By creating an ecosystem of support, we can address concerns related to accessibility, interoperability, patient education, and privacy. This cooperative mindset will

encourage the widespread adoption of smart inhalers, ensuring that everyone who suffers from asthma, irrespective of their financial status or demography, may take use of them. In conclusion, the use of smart inhalers to combine IoT technology with asthma medication is an exciting development in patient-centered care. The potential of these technologies to enhance medication adherence, symptom monitoring, and treatment customization is revolutionizing the care of asthma. In the future, there will be a clear call to action: continue pushing the boundaries of innovation, doing thorough research, and fostering collaborative ties. By doing this, we can make the most of the advantages offered by IoT-enabled smart inhalers, improving the lives of a great number of asthmatics and setting a precedent for how technology can transform the medical field.

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