***Abstract-­­­­­­––*** The COVID-19 pandemic has had a significant impact on healthcare systems and patient outcomes, including patient satisfaction with treatment and care. This study aims to understand patient satisfaction with COVID-19 treatment and care by using Internet of Things (IoT) applications and machine learning (ML) methods (Logistic regression, support vector machine, decision tree, random forest and neural network). The study will collect data from a convenience sample of patients receiving COVID-19 treatment and care and analyze the data to identify factors that contribute to patient satisfaction. Machine learning models will be developed to predict patient satisfaction and outcomes related to COVID-19. The study will provide insights into the impact of COVID-19 on patient satisfaction and inform healthcare decision-making to improve patient outcomes. The use of machine learning methods will provide a novel and innovative approach to addressing this important and timely research problem. The results of this study will contribute to our understanding of patient satisfaction with COVID-19 treatment and care and inform efforts to improve patient outcomes.

***Keyword:*** DT, NN, SVM, patient, satisfaction, covid-19, gathering, analyzing, machine learning, IOT.

# **INTRODUCTION**

IoT connects real-world things to the Internet so that data may be sent and received. It makes use of technologies including sensors, real-time analysis, ML, and embedded systems. The concept of "smart hospitals," along with other internet-controlled technology, is included. Smart gadgets have the ability to gather data and utilise it for activities in daily life. Healthcare, smart cities, automobiles, electronics, and entertainment systems all use IoT [1,2,3]. It uses sensors, medical equipment, AI, diagnostic tools, and cutting-edge imaging technology in healthcare [4,5]. It raises output and living conditions for both developed and emerging businesses and civilizations.

IoT links all-digital, mechanical, and computational devices to transmit data via the Internet without the use of any humans. This technology is expanding in order to keep track of healthcare during the COVID-19 Pandemic. Inaccurate and delayed health information is becoming a major cause of many fatalities [6, 7]. This technology uses sensors to immediately notify consumers of potential health issues. Giving patients the treatment they require may be made easier by the fact that all COVID-19 patient data is kept in the cloud. This system might track a person's daily activities and notify them of any health problems. [10, 8, 9]

IoT is essential to the effectiveness of medical procedures [11,12,13,14]. In especially during the COVID-19 pandemic, it enhances patient care. IoT real-time monitoring reduce the risk of passing away from conditions including high blood pressure, diabetes, heart failure, and asthma attacks [15,16,17]. Smart medical equipment may assess several health factors including blood pressure, weight, sugar levels, and oxygen levels and communicate health data to doctors via Bluetooth connectivity to a smartphone.

The proposed study is to understand patient satisfaction with COVID-19 treatment and care by using IoT applications and machine learning methods. The study aims to collect and analyze data on patient satisfaction, identify factors that contribute to patient satisfaction, and develop machine learning models to predict patient satisfaction and outcomes related to COVID-19. The study will provide insights into the impact of COVID-19 on patient satisfaction and inform healthcare decision-making to improve patient outcomes. The use of machine learning methods will provide a novel and innovative approach to addressing this important and timely research problem

# **RELATED WORK**

This paper [18] goal is to review the available ML applications and techniques that have been suggested to identify COVID-19 utilizing symptom variables and image processing. For COVID-19, the survey covers current methods such semantic technologies and IoT systems, and the findings are utilized to categorize the major problems and potential solutions. The study identifies problems and trends for future research as well as a conceptual framework for pandemic management.

The study [19] examines the difficulties that the COVID-19 epidemic has caused for both patients and medical professionals. The study suggests using IoT technology to lessen the pandemic's effects and provides a six-layer framework for IoT containment solutions. The report also examines the usage of unmanned aerial vehicles for contact tracing and the significance of machine learning in diagnosing COVID-19. According to the report, IoT may be efficiently applied in the healthcare industry in a number of ways to increase safety, improve health outcomes, and save costs.

The study [20] looks at the use of AI and IoT in combating the COVID-19 epidemic. The evaluation of the network, the deployment, and the participation of the IoT industry in early detection, quarantine measures, and post-recovery activities are the three main implementation processes. The research looks at how the Internet of Things is changing healthcare in the midst of the epidemic. For diagnostic reasons, the study especially examines cough and breathing acoustic features using a Long Short-Term Memory (LSTM) and Recurrent Neural Network (RNN). When compared to coughing and respiratory samples, the results indicate that voice tests are less accurate.

This study [21] provides a thorough analysis of the IoMT-based systems created for servial medical application, notably in relation to COVID-19. The IoMT applications and frameworks have been investigated for a variety of study kinds. Additionally, this study introduces cov-AID, an IoMT-based big data architecture that helps in COVID-19 prevention. In addition to helping COVID-19 patients get remote healthcare services by monitoring and treating them, the suggested framework also aids in identifying COVID-19 outbreak hotspots. The cov-AID system has promise for remote diagnosis, constant observation, pleasant, efficient home care, and virus prevention.

An IoT-based system for remote monitoring of COVID-19 hospitalized patients and at-home patients is presented in this work [22]. Scalability, interoperability, scenario analysis, serviceability, and secrecy are among the significant needs that are addressed. To guarantee lawful and ethical data collecting and to safeguard data privacy, a consent management module is implemented. The paper also outlines how to develop flexible scoring systems that are coupled with wearable technology to enhance the system's usability and adaptability for medical professionals.

In the current research [23], COVICT, a COVID-19 detection and monitoring system powered by IoT with increased contact tracing capabilities and semi-automation, has been described. It uses real-time data on symptoms gathered from people as well as contact tracing. By enforcing Smart Lockdown, COVICT can be deployed, infected individuals can be predicted with more accuracy, and contaminated places can be located to stop the virus from spreading further. For regulatory authorities to establish policies to combat COVID-19, the suggested IoT-based architecture can be very useful.

An IoT-based COVID-19 prevention and management system is suggested by this study [24]. It explains how to build an interior location system with the iBeacon network and a real-time locating system based on fingerprints. The system is adasptable for risk analysis, navigation, and reservation processes. The positioning system is efficient, according to testing. A thorough framework for COVID-19 prevention and control may be provided by the risk assessment model, which is appropriate for enclosed places and can be included into a wider big data pandemic prevention and management system that is supported by the government.

This study [25] suggested an IoT-based real-time detection system. The system properly gathers and analyzes the datasets, collects real-time data from users to identify possible covid-19 cases, and analyzes treatment responses for those who have received therapy. A different approach to making decisions is to use artificial intelligence-based algorithms to glean important information from clinical data. In order to enhance patient categorization, a deep learning (DL) optimization system that can function with unbalanced datasets was created in this research. In addition, a synthetic minority oversampling method was adopted in order to overcome the problem of imbalance data. Furthermore, a recursive feature removal procedure is employed to identify the most useful characteristics.

# **RESEARSH PROBLEM**

The research problem for the proposed project could be stated as follows:

"The COVID-19 pandemic has had a profound impact on healthcare delivery and patient outcomes. Despite efforts to respond to the pandemic, patients continue to experience a range of challenges related to treatment and care. There is a need to understand patient satisfaction with COVID-19 treatment and care and to identify factors that contribute to this satisfaction. This understanding is critical to improving patient outcomes and addressing the ongoing challenges of the COVID-19 pandemic."

The mentioned problem highlights the importance of understanding patient satisfaction with COVID-19 treatment and care and the need to use data and technology to improve patient outcomes. The proposed research project will address this problem by using ML methods to analyze the gathered data from IoT applications and predict patient satisfaction and outcomes related to COVID-19.

# **AIMS AND OBJECTIVES**

The aims and objectives of the proposed research project could be stated as follows:

**Aims:**

1. To understand the coronavirus treatment and care taking into account the patient satisfaction.
2. To identify factors that contribute to patient satisfaction.

**Objectives:**

1. To collect and analyze data on patient satisfaction using IoT applications
2. To propose and evaluate ML models to predict patient satisfaction and outcomes related to COVID-19
3. To determine the utility of machine learning methods for analyzing mixed-methods data in healthcare
4. To inform healthcare decision-making and improve patient outcomes related to COVID-19 through targeted interventions.

These aims and objectives highlight the importance of using data and technology to improve patient outcomes and address the ongoing challenges of the COVID-19 pandemic. The proposed research project will contribute to the existing literature and have practical implications for healthcare delivery.

# **RESEARSH LIMITATION**

The study limitations of the proposed research project could include:

1. Data availability and quality: The study will rely on data collected from IoT applications, and the quality and availability of this data may be limited. There may also be concerns about the accuracy and reliability of the data.
2. Patient privacy: The study will involve collecting sensitive information about patients, and there may be concerns about patient privacy and confidentiality.
3. Technical limitations: The study will involve using complex machine learning methods, and there may be limitations in the technology and infrastructure used for the study.
4. Sampling bias: The study will use a convenience sample, and there may be concerns about the representativeness of the sample and the generalizability of the results.
5. Model limitations: The study will use machine learning models to analyze the data, and there may be limitations in the accuracy and reliability of these models.
6. Ethical considerations: The study will involve collecting and analyzing sensitive information about patients, and there may be ethical considerations related to data privacy, confidentiality, and informed consent.

These limitations should be carefully considered and addressed in the study design and implementation. The study should also be designed to minimize these limitations as much as possible to ensure the validity and reliability of the results.

# **RESEARSH QUESTIONS**

The questions have to be answered in this research are the following:

* What is the level of patient satisfaction?
* What factors contribute to patient satisfaction?
* Can machine learning models accurately predict patient satisfaction?
* How do machine learning models perform in comparison to traditional methods of predicting patient satisfaction?
* What implications do the results of this study have for healthcare decision-making and patient outcomes related to COVID-19?

These research questions will guide the study and help to achieve the research aims and objectives. The answers to these questions will contribute to our understanding of patient satisfaction with COVID-19 treatment and care and inform efforts to improve patient outcomes.

# **METHODOLGY**

The methodology for the proposed research project could include the following steps:

1. Data collection: IoT applications will be used to collect data on patient satisfaction with COVID-19 treatment and care. Data will be collected from a convenience sample of patients receiving COVID-19 treatment and care.
2. Data cleaning and preparation: The gathered information will be cleansed and made ready for examination. Missing values will be eliminated, outliers will be handled, and any necessary variable transformations will be made.
3. Exploratory data analysis: Exploratory data analysis will be used to describe the characteristics of the data and identify potential relationships between variables. This will include univariate analysis, bivariate analysis, and descriptive statistics.
4. Model development: Machine learning models will be developed to predict patient satisfaction and outcomes related to COVID-19. This will include selecting appropriate algorithms, tuning model parameters, and evaluating model performance.
5. Model evaluation: The developed models will be evaluated using appropriate performance metrics. The models will be compared to determine the best-performing model.
6. Results interpretation: The results of the analysis will be interpreted and discussed in the context of the research aims and objectives. The implications of the results for healthcare decision-making and patient outcomes will be discussed.

Conclusion and recommendation: The study will conclude with a discussion of the findings and a summary of the main contributions of the study. Recommendations for future research will also be provided.

This methodology will provide a structured approach to addressing the research problem and achieving the research aims and objectives. The use of machine learning methods will provide a novel and innovative approach to analyzing patient satisfaction with COVID-19 treatment and care

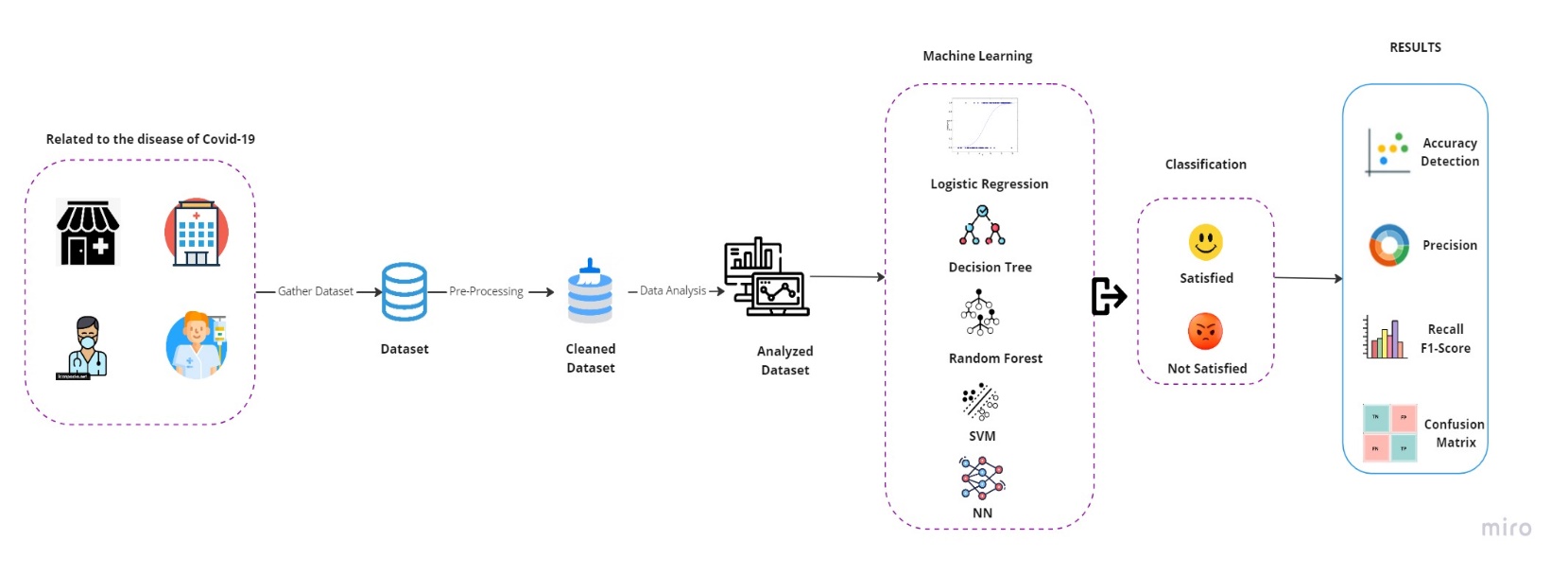


Figure ‎6.1: Proposed Model

# **CONCLUSION**

The proposed research project will contribute to our understanding of the role of IoT-enabled remote monitoring systems in improving patient outcomes and satisfaction during the COVID-19 pandemic, and demonstrate the potential of machine learning methods for enhancing healthcare research. The findings will have important implications for the development of future remote monitoring systems for healthcare, and will help to improve patient care during pandemics.

# **REFERENCES**

[1]: M. Nasajpour, S. Pouriyeh, R.M. Parizi, M. Dorothy, M. Valero, H.R. Arabnia “Internet of Things for current COVID-19 and future pandemics: an exploratory study” J Healthc Inf Res (2020 Nov 12), pp. 140

[2]: Y. Liu, B. Dong, B. Guo, W. Peng “Combination of cloud computing and Internet of things (IoT) in medical monitoring systems” Int J Hospit Inf Technol, 8 (12) (2015), pp. 367-376

[3]: D. Shin, Y. Hwang “Integrated acceptance and sustainability evaluation of Internet of Medical Things: a dual-level analysis” Internet Res, 27 (5) (2017), pp. 1227-1254

[4]: M.S. Rahman, N.C. Peeri, N. Shrestha, R. Zaki, U. Haque, S.H. Ab Hamid “Defending against the novel coronavirus (COVID-19) outbreak: how can the internet of things (IoT) help to save the world?”Health Pol Technol (2020 Apr 22)

[5]: M. Javaid, A. Haleem, R. Vaishya, S. Bahl, R. Suman, A. Vaish “Industry 4.0 technologies and their applications in fighting COVID-19 pandemic” Diabetes Metabol Syndr: Clin Res Rev (2020), 10.1016/j.dsx.2020.04.032

[6]: S. Singh, A. Bansal, R. Sandhu, J. Sidhu Fog computing and IoT based healthcare support service for dengue fever Int J Pervasive Comput Commun, 14 (2) (2018), pp. 197-207

[7]: L. Bai, D. Yang, X. Wang, et al. “Chinese experts’ consensus on the Internet of Things-aided diagnosis and treatment of coronavirus disease 2019 (COVID-19)” Clin eHealth, 3 (2020 Jan 1), pp. 715

[8]: K. Michalakis, G. Caridakis “IoT contextual factors on healthcare” Adv Exp Med Biol, 989 (2017), pp. 189-200

[9]: F.H. Alqahtani “The application of the internet of things in healthcare” Int J Comput Appl, 180 (18) (2018), pp. 19-23

[10]: K. Kumar, N. Kumar, R. Shah “Role of IoT to avoid spreading of COVID-19” Int J Intell Netw, 1 (2020 Jan 1), pp. 32-35

[11]: D.C. Klonoff “Fog computing and edge computing architectures for processing data from diabetes devices connected to the medical internet of things” J Diabetes Sci Technol, 11 (4) (2017), pp. 647-652

[12]: A. Haleem, M. Javaid “3D scanning applications in medical field: a literature-based review” Clin Epidemiol Glob Health, 7 (2) (2019), pp. 199-210

[13]: V. Singh, H. Chandna, A. Kumar, S. Kumar, N. Upadhyay, K. Utkarsh “IoT-Q-Band: a low-cost internet of things based wearable band to detect and track absconding COVID-19 quarantine subjects” EAI Endorsed Trans Internet of Things, 6 (21) (2020 Jun 16)

[14]: P.K. Gupta, B.T. Maharaj, R. Malekian “A novel and secure IoT based cloud-centric architecture to perform predictive analysis of users activities in sustainable health centres” Multimed Tool Appl, 76 (18) (2017), pp. 18489-18512

[15]: M. Rath, B. Pattanayak “Technological improvement in modern health care applications using the Internet of Things (IoT) and proposal of a novel health care approach” Int J Human Rights Healthc, 12 (2) (2019), pp. 148-162

[16]: M. Room, N. Otoum, M.A. Alzubaidi, Y. Etoom, R. Bandhani “An IoT-based framework for early identification and monitoring of COVID-19 cases” Biomed Signal Process Contr, 62 (2020 Sep 1), p. 102149

[17]: S. Kumar, R.D. Raut, B.E. Narkhede “A proposed collaborative framework by using artificial intelligence-internet of things (AI-IoT) in COVID-19 pandemic situation for healthcare workers “Int J Healthc Manag, 13 (4) (2020 Oct 1), pp. 337-345

[18]: Zgheib, Rita, et al. "Towards an ML-Based Semantic IoT for Pandemic Management: A Survey of Enabling Technologies for COVID-19." *Neurocomputing* (2023).

[19] : Ajaz, Farhana, et al. "COVID-19: challenges and its technological solutions using IoT." *Current Medical Imaging* 18.2 (2022): 113-123.

[20] : Kollu, Praveen Kumar, et al. "Development of advanced artificial intelligence and IoT automation in the crisis of COVID-19 Detection." *Journal of Healthcare Engineering* 2022 (2022).

[21] : Hamid, Soomaiya, et al. "A Systematic Review and IoMT Based Big Data Framework for COVID-19 Prevention and Detection." *Electronics* 11.17 (2022): 2777.

[22] : Paganelli, Antonio Iyda, et al. "A conceptual IoT-based early-warning architecture for remote monitoring of COVID-19 patients in wards and at home." *Internet of Things* 18 (2022): 100399.

[23] : Wahid, Mirza Anas, et al. "COVICT: an IoT based architecture for COVID-19 detection and contact tracing." *Journal of Ambient Intelligence and Humanized Computing* (2022): 1-18.

[24] : Yang, Cunwei, et al. "An IoT-based COVID-19 prevention and control system for enclosed spaces." *Future Internet* 14.2 (2022): 40.

[25] : Mohammedqasim, Hayder, and Oguz Ata. "Real-time data of COVID-19 detection with IoT sensor tracking using artificial neural network." *Computers and Electrical Engineering* 100 (2022): 107971.