

A Novel Approach to Ceiling Fan-Based System for Preventing Suicide by Hanging

Rachit Srivastava^{1,*}, Siddhartha Sankrit²

Abstract

Suicide by hanging has become a significant public health issue in India. According to reports from the National Crime Records Bureau (NCRB), a considerable number of hanging cases are reported annually, with the majority being suicidal in nature. Homicidal cases disguised as hanging are extremely rare. Accurate differentiation between suicidal and homicidal hanging requires thorough examination of the crime scene in an undisturbed condition, followed by a detailed autopsy investigation. This study aims to analyze the factors associated with suicide by hanging in India and identify potential areas for preventive intervention. A unique method to lessen suicide attempts employing ceiling fans is suggested as a solution to this problem. The system integrates hardware components such as a RENESAS microcontroller, PIR sensor, force sensor, buzzer, GSM module, switch, and DC motor, along with software tools including Cube Suite+ and RENESAS Flash Programmer. The system's operation relies on the use of a force sensor to measure weight. When the applied load exceeds a predefined threshold, the supporting beam elongates and moves downward, preventing the act of hanging. Simultaneously, an alarm is activated, and the GSM module sends alert messages to designated guardians. An embedded algorithm continuously monitors and controls the motion and speed of the beam to ensure rapid response and effective prevention. The proposed system provides a practical and technological approach to reducing suicide attempts and enhancing safety in residential environments.

Keywords: Suicide prevention, hanging detection, ceiling fan safety system, force sensor, PIR sensor, GSM module, RENESAS microcontroller, embedded system, public health, India

INTRODUCTION

Suicide is a major global public health concern, accounting for a significant number of deaths each year. Among the various methods, hanging is one of the most commonly adopted means because of its accessibility, simplicity, and high fatality rate [1]. In India, the situation is particularly alarming, as highlighted by reports from the National Crime Records Bureau (NCRB), which indicate a continuous rise in suicide cases, especially among young adults. A large proportion of these incidents occur in domestic environments, where ceiling fans are frequently used as suspension points owing to their availability and structural suitability [2, 3].

*Author for Correspondence

Rachit Srivastava
E-mail: srivastava.rachit94@gmail.com

¹Assistant Professor, Department of Electrical Engineering, Bansal Institute of Engineering & Technology, Lucknow, Uttar Pradesh, India

²Student, Department of Electrical Engineering, Bansal Institute of Engineering & Technology, Lucknow, Uttar Pradesh, India

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Figure 1 shows a block diagram of the anti-suicide ceiling fan. Despite increasing awareness and preventive measures, such as counseling and mental health support, the rate of suicide by hanging remains high. Traditional approaches primarily focus on psychological and social interventions; however, there is a growing need for engineering-

based solutions that provide immediate physical prevention. In recent years, advancements in embedded systems, sensors, and communication technologies have opened new possibilities for developing smart safety devices aimed at reducing such incidents [4, 5].

This study proposes a novel ceiling fan-based system designed to prevent suicide attempts by hanging. The core idea is to integrate sensing and control mechanisms into a conventional ceiling fan structure, enabling it to detect abnormal load conditions and respond appropriately. The system employs a force sensor to monitor weight variations and a PIR sensor to detect human presence. When the applied load exceeds a predefined threshold, the system activates a mechanical response that lowers the supporting structure, thereby preventing the suspension. Simultaneously, an alert mechanism involving a buzzer and GSM module notifies guardians or nearby individuals for immediate assistance [6, 7].

The proposed approach combines hardware and software components, including a RENESAS microcontroller for control operations and embedded algorithms for real-time monitoring and responses. By introducing an automated and responsive mechanism, this system aims to bridge the gap between technological innovation and social safety. This study contributes to the fields of embedded systems and safety engineering and provides a practical solution to address a critical societal issue [8, 9].

LITERATURE REVIEW

Table 1 presents a comparative overview of existing studies related to ceiling fan safety systems, suicide prevention strategies, smart monitoring technologies and structural safety mechanisms. The reviewed works demonstrate that researchers have explored both electronic and mechanical approaches to minimize the fatalities associated with hanging incidents. The ceiling-fan-based suicide prevention system utilizes load sensors integrated with a microcontroller to detect abnormal loading conditions and initiate a safety response. Although this approach enables automatic detection, its effectiveness may be limited because it relies primarily on electronic sensing and does not incorporate a dedicated mechanical fail-safe mechanism [10].

Global suicide prevention research emphasizes broader public health interventions rather than hardware-based solutions to address the issue. These studies consistently identified restrictions, awareness programs, and timely interventions as effective strategies for reducing suicide rates. However, they do not provide practical device-level implementations that can directly prevent incidents from occurring within residential environments [11].

Research on smart monitoring systems has highlighted the integration of sensors, embedded controllers, and Internet of Things (IoT) technologies for continuous surveillance and real-time alert generation. These systems allow remote monitoring and rapid notification of caregivers or emergency contacts when abnormal conditions are detected. Despite these advantages, their deployment is often associated with increased system complexity, higher installation costs, network dependency, and maintenance requirements, which may restrict their large-scale adoption [12].

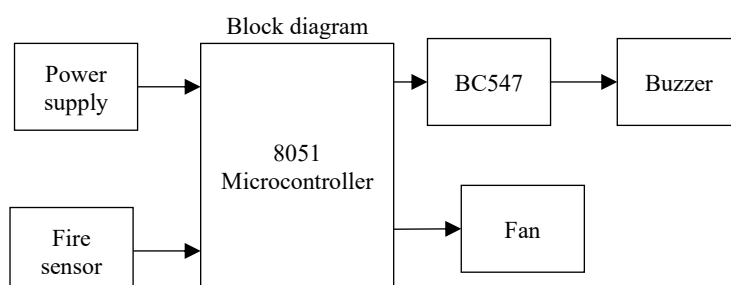


Figure 1. Block diagram of anti-suicide ceiling fan.

Table 1. Comparative overview of existing studies.

S.N.	References	Title of paper	Methodology used	Key findings	Limitations
2	[13]	Ceiling fan-based suicide prevention system	Load sensor + microcontroller-based detection	Detects abnormal load and triggers safety response	Lacks mechanical safety backup
4	[14]	Global suicide prevention strategies	Statistical and policy-based study	Means restriction is effective globally	No device-level implementation
5	[13], [15], [7]	Smart monitoring systems	Sensor + IoT-based monitoring	Real-time alerts and remote monitoring possible	High cost and complexity
6	[16], [17]	Structural modification of fixtures	Weak-link / collapsible support design	Prevents full load application	Risk of accidental triggering

Mechanical safety design studies focus on structural modifications, such as weak-link mechanisms or collapsible support structures that release or deform when subjected to excessive loads. These designs reduce the possibility of sustaining the full body weight required for hanging and, therefore, provide an additional level of passive protection. However, inappropriate calibration of the release thresholds may result in accidental triggering during normal operation or failure to activate under critical conditions [18].

Overall, the comparative analysis revealed that existing solutions generally address either electronic monitoring or mechanical protection independently. A comprehensive and reliable ceiling fan safety system should integrate intelligent sensing, rapid alert generation, and robust mechanical safety features to overcome the limitations of individual approaches and improve the practical effectiveness in real-world applications.

METHODOLOGY

The proposed ceiling fan-based suicide prevention system was designed using an embedded system approach that integrates sensing, control, and alert mechanisms. The methodology is divided into system design, hardware implementation, software development, and operational workflows.

System Design Overview

The system was developed to detect abnormal load conditions on a ceiling fan and respond immediately to prevent suicide attempts. The system consists of sensors, a microcontroller unit, an alert system, and a mechanical response mechanism. The design ensures real-time monitoring, rapid decision-making, and automated actuation.

Hardware Components

The major hardware components used in the system are as follows:

- *RENESAS Microcontroller*: Acts as the central processing unit to control all system operations.
- *Force Sensor*: Measures the load applied to the ceiling fan. It plays a critical role in detecting abnormal weight.
- *PIR Sensor (Passive Infrared Sensor)*: Detects human presence and motion in the room.
- *GSM Module*: Sends alert messages to predefined mobile numbers in emergency situations.
- *Buzzer*: Provides an immediate audible alarm when abnormal conditions are detected.
- *DC Motor*: Controls the movement of the mechanical beam to prevent hanging.
- *Switch*: Used for manual operation and system control.

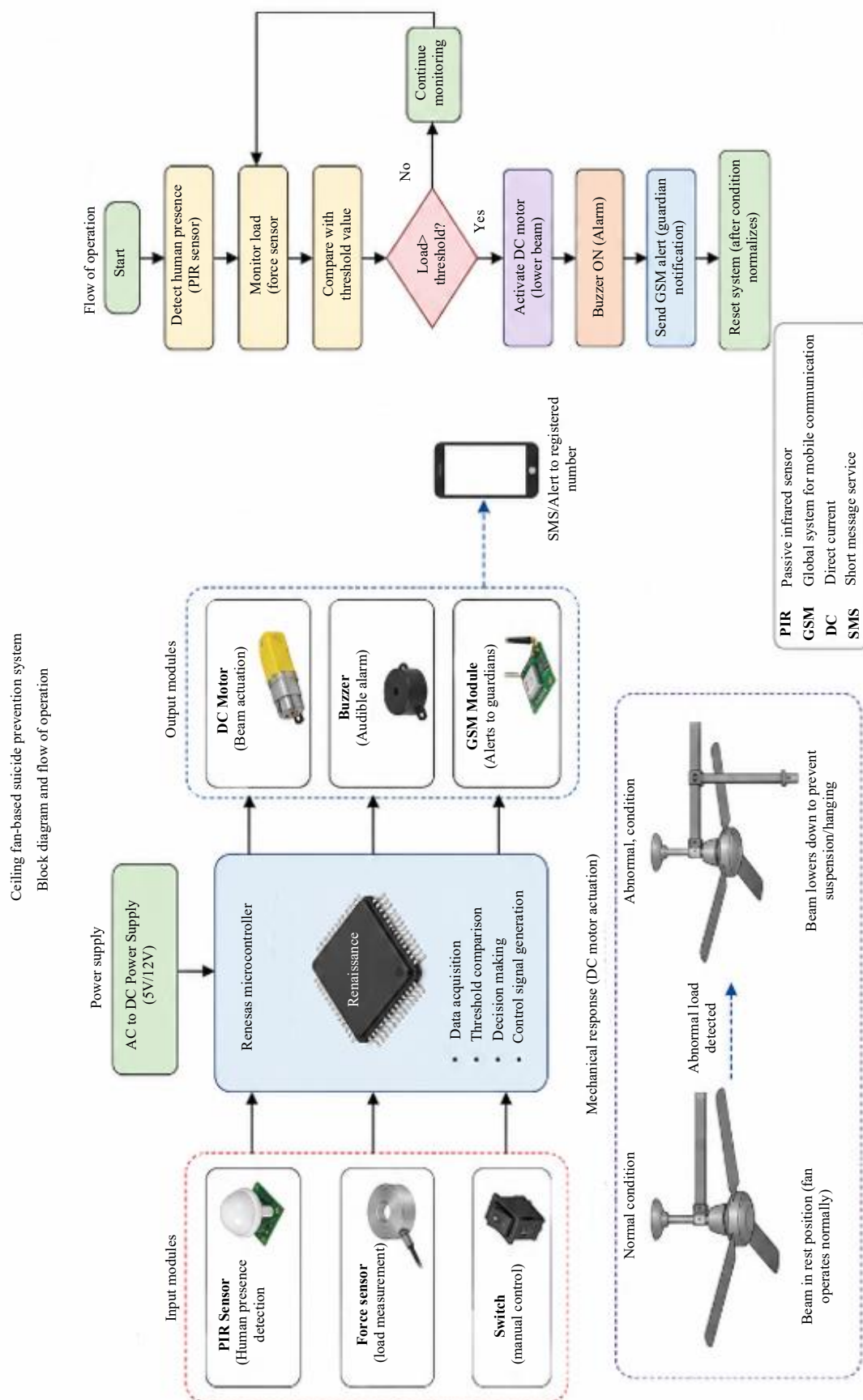


Figure 2. Block diagram of the proposed embedded ceiling fan-based suicide prevention system.

Software Tools and Programming

The software part of the system is developed using:

- *Cube Suite+*: Used for coding, compiling, and debugging the embedded program.
- *RENESAS Flash Programmer*: Used to upload the program into the microcontroller.

An embedded algorithm was designed to continuously monitor the sensor data, compare them with predefined thresholds, and trigger the necessary actions.

The proposed ceiling fan-based suicide prevention system, as shown in Figure 2, is designed using an embedded system approach that integrates sensing, control, and alert mechanisms. The methodology is divided into system design, hardware implementation, software development, and operational workflows.

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Working Principle

The system operates based on continuous monitoring and automated response:

1. The PIR sensor detects the presence of a person near the ceiling fan.
2. The force sensor continuously measures the load applied to the fan.
3. The sensed weight is compared with a predefined threshold stored in the microcontroller.
4. If the detected weight exceeds the threshold:
 - The system identifies it as a potential suicide attempt.
 - The DC motor activates and lowers the supporting beam to prevent suspension.
 - The buzzer generates an alarm to alert nearby individuals.
 - The GSM module sends emergency messages to registered guardians.
5. The system algorithm ensures controlled speed and movement of the beam for safe operation.

Flow of Operation

- Start system
- Detect human presence (PIR sensor)
- Monitor load (Force sensor)
- Compare with threshold value
- If normal → continue monitoring
- If abnormal → trigger motor + buzzer + GSM alert
- Reset system after condition normalizes

Safety and Reliability Considerations

- Threshold values are carefully calibrated to avoid false triggering.
- The system ensures smooth mechanical movement to prevent accidental injury.
- Continuous monitoring improves reliability and response time.
- The alert system provides both local (buzzer) and remote (GSM) notifications to the user.

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FUTURE SCOPE

The proposed ceiling fan-based safety system is a promising approach for the detection and prevention of hanging incidents. However, further enhancements can be implemented to improve the efficiency, reliability, and applicability of the system. In future work, the integration of artificial intelligence and machine learning techniques can enable the predictive analysis of human behavior, allowing the system to identify potential risks before an incident occurs. Additionally, incorporating multiple sensors, such as motion, vibration, and infrared sensors, can enhance detection accuracy and significantly reduce the possibility of false alarms.

Moreover, the system can be extended by integrating a GSM communication module to ensure alert transmission in areas with limited or no Internet connectivity. Cloud-based data storage and analytics

can also be incorporated to enable continuous monitoring, historical data analysis, and remote access by caregivers or authorities. Another important improvement is the development of a mechanical safety mechanism that can automatically release or detach the ceiling fan under excessive load conditions, thereby physically preventing the act of hanging.

Furthermore, implementing a dedicated mobile application can provide real-time notifications, system status updates, and emergency response features. Integration with smart home automation systems can also enhance overall functionality and user convenience. To ensure uninterrupted operation, especially during power failures, the system can be equipped with a battery-backup unit. Finally, future research should focus on cost optimization and large-scale deployment of the system in residential buildings, hostels, hospitals, and other public facilities, making it a practical and widely adoptable solution for enhancing safety and preventing suicide attempts.

CONCLUSION

This paper presents a novel ceiling fan-based safety system designed to detect and prevent hanging incidents using an embedded IoT-based approach. The proposed system utilizes a load sensor to continuously monitor the weight applied to the ceiling fan and identifies abnormal conditions that may indicate a potential attempt to hang. Upon detection, the system initiates immediate preventive actions, including alarm generation, power disconnection, and real-time alert transmission to the concerned individuals.

The trial outcomes show that the system can quickly and reliably identify abnormal loads, guaranteeing prompt intervention. Compared with existing methods, such as camera-based surveillance and wearable devices, the proposed system offers advantages in terms of cost-effectiveness, ease of installation, real-time operation, and preservation of user privacy. Although certain limitations exist, such as the possibility of false triggering and dependence on proper calibration, the overall performance of the system indicates its practical feasibility in real-world applications.

In summary, the proposed system offers a creative and dependable method for improving safety in both public and home settings. With further improvements and large-scale implementation, this approach has the potential to significantly contribute to the prevention of suicide by hanging and to improve overall human safety.

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REFERENCES

1. Siecker J, Kusakana K, Numbi EB. A review of solar photovoltaic systems cooling technologies. *Renew Sustain Energy Rev.* 2017;79:192-203.
2. Teo HG, Lee PS, Hawlader MNA. An active cooling system for photovoltaic modules. *Appl Energy.* 2012;90(1):309-15.
3. Gubbi J, Buyya R, Marusic S, Palaniswami M. Internet of Things (IoT): a vision, architectural elements, and future directions. *Future Gener Comput Syst.* 2013;29(7):1645-60.
4. Sharaf M, Yousef MS, Huzayyin AS. Review of cooling techniques used to enhance the efficiency of photovoltaic power systems. *Environ Sci Pollut Res Int.* 2022;29(18):26131-59.

5. Atzori L, Iera A, Morabito G. The internet of things: a survey. *Comput Netw.* 2010;54(15):2787-805.
6. Zafar S, Miraj G, Baloch R, Murtaza D, Arshad K. An IoT based real-time environmental monitoring system using Arduino and cloud service. *Eng Technol Appl Sci Res.* 2018;8(4):3238-42.
7. Malinowski A, Yu H. Comparison of embedded system design for industrial applications. *IEEE Trans Ind Inform.* 2011;7(2):244-54.
8. Chandramohan J, Nagarajan R, Satheeshkumar K, Ajithkumar N, Gopinath PA, Ranjithkumar S. Intelligent smart home automation and security system using Arduino and Wi-Fi. *Int J Eng Comput Sci.* 2017;6(3):20694-8.
9. Erickson RW, Maksimović D. *Fundamentals of power electronics*. 2nd ed. New York: Springer; 2007.
10. Wang P, Chen X, Ye F, Sun Z. A survey of techniques for mobile service encrypted traffic classification using deep learning. *IEEE Access.* 2019;7:54024-33.
11. Pantelopoulos A, Bourbakis NG. A survey on wearable sensor-based systems for health monitoring and prognosis. *IEEE Trans Syst Man Cybern C Appl Rev.* 2010;40(1):1-12.
12. Shahjalal M, Hasan MK, Islam MM, Alam MM, Ahmed MF, Jang YM. An overview of AI-enabled remote smart-home monitoring system using LoRa. In: 2020 International Conference on Artificial Intelligence in Information and Communication (ICAIIIC); 2020 Feb 19. IEEE. p. 510-3.
13. Sung WT, Hsu YC. Designing an industrial real-time measurement and monitoring system based on embedded system and ZigBee. *Expert Syst Appl.* 2011;38(4):4522-9.
14. World Health Organization. *Suicide worldwide in 2021: global health estimates*. Geneva: World Health Organization; 2025 May 22.
15. López-Vargas A, Fuentes M, Vivar M. IoT application for real-time monitoring of solar home systems based on Arduino™ with 3G connectivity. *IEEE Sens J.* 2019;19(2):679-91.
16. Wang D, Dong M, Zhu L, Lou X, Yu M, Zhang Y, et al. Application of fiber-optic strain sensing technology in high-precision load prediction of aircraft landing gear. *Opt Laser Technol.* 2025;182:112183.
17. Hunter GW, Stetter JR, Hesketh P, Liu CC. *Smart sensor systems*. Electrochem Soc Interface. 2010;19(4):29-34.
18. Nanayakkara T, Sahin F, Jamshidi M. *Intelligent control systems with an introduction to system of systems engineering*. Boca Raton (FL): CRC Press; 2018.