Grenze International Journal of Engineering and Technology, June Issue

Innovative Ceiling Fan based Suicide Prevention System

Vasepalli Mounika[1], Swathi Nadipineni[2], Veeranki Hari Babu[3], Posina Balaji Pavan[4] and Md. Firose Shaik[5]
[1,3-4]Department of EIE, V.R. Siddhartha Engineering College, Vijayawada, India
Email: 228w1a1056@vrsec.ac.in, 228w1a1057@vrsec.ac.in, 228w1a1045@vrsec.ac.in
[2]Department of EIE, Siddhartha Academy of Higher Education, Deemed to be University, Vijayawada, India
Email: swathinadipineni@vrsiddhartha.ac.in
[5]Department of CSE, Vasireddy Venkatadri International Technological University, Namburu, India
Email: firosecolab@gmail.com

***Abstract*—Suicide prevention is a timely issue in public health, with ceiling fans frequently used to impulsively harm oneself, and measures aimed at engaging in proactive steps to guarantee safety on the household level are needed. To address this nagging problem, the proposed system will consist of a spring-loaded mechanical rod, flex and PIR sensors, a GSM communication module and a control unit that will be powered by a microcontroller to sense when the abnormal conditions load is detected and interfere. This method involves building a weight-sensitive extension gadget that reduces cervical strain by using sensors to detect abnormal movement or posture, sending a signal to chosen individuals, and preserving the daily operational routines of the ceiling fan.**

The output of initial functional testing suggests that the spring mechanism is effective in disintegrating harmful loads, sensors are sufficiently accurate to identify dangerous situations, and the GSM system is always responsive to send real-time alerts, thus providing immediate help in case of an emergency. A conclusion is made to repeat that this integrated design is not costly, in addition to being versatile for homes, hostels and communal centres with a feasible way to cut fatalities. With such a combination of artificially created protective measures and a smart form of surveillance, the system proves to have a high potential as a preventative measure intended to save the lives and strengthen the efforts that have been taken by the community to fight suicidal tendencies at the community-wide level.

***Index Terms*— Suicide prevention, mechanical intervention, PIR sensor, flex sensor, GSM alerts, household safety system, emergency response, IoT-based prevention.**

I. INTRODUCTION

Suicide has been one of the biggest health burdens in the world, claiming hundreds of thousands of lives each year, and leaving families and societies to endure years of emotional, social and economic impacts, [17]. In most areas, especially in South Asian families, ceiling fans are being unfortunately employed as an easily available means of momentary self-destructive attacks. This has pushed the urgent need to develop engineering preventative measures that will come into play at the environmental level before a life ends due to these conditions. Conventional awareness and even psychological interventions, though necessary, might not provide immediate protection at the time of crisis.

Grenze ID: 01.GIJET.12.2.503_26

Therefore, together with a smart strategic inclusion of preventive mechanisms into domestic infrastructure, is a feasible and complementary solution [9].
In this respect, the mechanical safety system implementation into the ceiling fans can be considered a promising way [20]. The concept is not elaborate and extreme in its effect: the self-inflicted attempt of causing harm is interfered with the mechanical force there by the pressure that kills a neck is taken off. Such an intervention is a spring-loaded rod to be extended when abnormal weight has been detected. This load-bearing guard is basically a mechanical protection which transforms a potentially fatal load-bearing structure into a pressure-reducing mechanism to protect against suffocation at the rightest time [16].
Nevertheless, mechanical interference might not be enough, and a fast response of the human factor can make the difference between life and death [19]. In this case, therefore, sensor types such as PIR and flex sensors would make an extremely potent addition since, they are in a position to detect any abnormal movement, posture or force pattern. These sensors, along with a GSM communication unit, can enable real-time notifications to the family members, carers or local emergency contacts [10], [18].
With the addition of a microcontroller-based control unit, the overall structure becomes unified, where sensor inputs are handled, mechanical release triggers are sent, and alerts are sent with a large degree of time accuracy [12]. Most importantly, the system will maintain the entire ceiling fan functionality without undermining its daily functionality with safety considerations [14]. The prototype generated is cheap, decent, and will fit in any house, hostel, or government institutions [15]. The proposed system will link theory and practice of prevention to household safety through engineering creativity and behavioural knowledge, and understanding of ensuring safety, thus it is given a concrete path towards preventing deaths and enhancing an infrastructure of suicide-prevention in the community [13].

II. Literature Survey

The topic of suicide prevention in domestic settings has become an issue of growing academic interest in situations where structural features like ceiling fans do not contribute to the process of impulsive self-harm. The studies on home-based safety systems emphasise the need to place preventative technologies deep into household systems in order to detect harmful trends before they lead to deadly outcomes. Research has also established those intelligent home-based protective systems have the potential to largely decrease death rates through the integration of mechanisation protection with intelligent sensor systems, forming a platform upon which judgment-initiating approaches rather than reactionary methods can be promoted [1]. Such a perspective change, rather than focusing on managing crises once they take place, is based on preventing crises on the environmental level, which constitutes an essential conceptual underpinning of the suggested system.
Simultaneously, the development of the Internet of Things-based emergency response capabilities contributed to the intensification of the opportunities to identify the presence of risky behaviour and promptly activate notifications. The research literature on IoT-assisted interventions in people at risk of self-injury targets the real-time situational awareness, expedited data delivery, and automated decision support as the prerequisites of life-saving interventions [2]. The following works help to see that the emergency communication networks, closely integrated with embedded sensors, can significantly decrease the time lag between detection and human response. This observation drives the necessity to integrate real-time GSM-based messages and sensor integration in residential suicide-prevention systems.
Mechanical safety engineering is also a critical measure in averting the potentially fatal conditions in household appliances. Laboratory studies on load-sensitive mechanical properties revealed that the technology that may identify abnormal force can interrupt pernicious behaviours with the aid of mechanical diminishing of applied force, which consequently disables physical traumas [3]. The awareness of such is the direct contribution to the design of a spring-loaded rod system that would expand under extreme weight in order to relieve cervical pressure in case of a hanging attempt. These principles of mechanical design give tangible indications that the intervention, based on engineering, at the time of crisis, can greatly minimise the risk of fatality.
The addition of automatic alerting systems in health and safety systems has been supported by complementary literature on the importance of incorporating communication technologies in health and safety. The GSM-triggered emergency systems have been extensively investigated to remotely inform the caregivers and medical support teams, and have proved to be very efficient in relaying signs of distress with very short latency [4]. These systems are also functional at low-bandwidth conditions, thus suitable in-house-based scenarios where there are options of saving lives based on timely response. This kind of revelation supports the purpose of incorporating GSM modules in the production of anti-suicide ceiling fans.

The sensor technology is also another significant research area in support of this project. Research regarding the use of PIR, vibration, and flex sensors to monitor human activity emphasises the fact that these methods accurately identify abnormal gait patterns, abnormal posture changes and skewed loaded states [5]. Subsequent developments of sensor fusion, namely between PIR and flex sensors, have demonstrated increased accuracy in detecting critical behavioural changes which can be used to suggest an emergency [6]. This fact indicates that multiple sensor modes can significantly enhance early suicide attempt detection to ensure that the system is responsive and accurate.

Lastly, the studies conducted on microcontroller-based safety and fail-safe systems have a strong basis on which to apply a coordinated control architecture. The research work on mechanical fail-safe designing of household appliances clearly indicates that it is important to include the smart controllers in the process of synchronisation of sensing, mechanical execution, and notification in the domestic appliances under one single and coherent workflow [7]. The extra literature about embedded risk-mitigation systems has an authoritative part in the analysis of sensor data, implementation of programmed safety routines, and external network communications between the microcontroller [8]. Still further research on smart-home safety systems, GSM-based emergency infrastructures, and other related complementary literature proves that smart-home integration of sensing, mechanical and communication systems is indeed possible to build a single, protection-guaranteeing system [9, 10, 11]. In general, these sources offer a robust theoretical and technical basis in the creation of the intelligent, spring-loaded, and IoT-enabled system of anti-suicide ceiling fans.

III. Proposed Methodology

The basis of the suggested system is a mechanical redesign of the mounting assembly of the ceiling fan in such a manner that it includes a spring-loaded or motorised mechanism for lowering the fan. This system enables the fan to slowly move down automatically when an abnormal weight is detected, and this gives immediate relief to the neck and could also prevent suffocation as shown in Fig. 1.

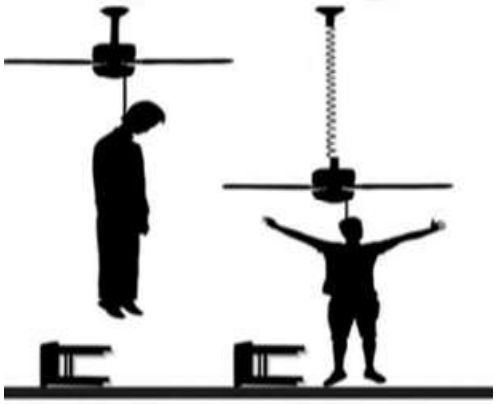

Figure 1: Model of suicide prevention system

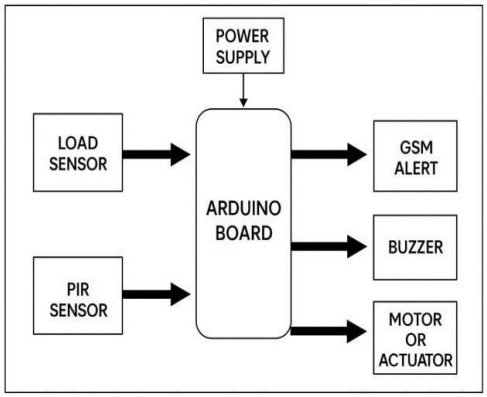

Figure 2: Block diagram of the Proposed Model

Safety tethers or mechanical stoppers are used to ensure a controlled drop distance, which is normally 20-30 cm, to prevent injury and structural damage to the fan. The design gives priority to the fact that the system is non-obtrusive to the normal running of the system, although with an efficient mechanical intervention when required.

The detection system uses sensor integration for which the block diagram is shown in Fig. 2. There is a Passive Infrared (PIR) sensor that is mounted to determine whether a person is present in the space right under the fan to differentiate normal activity, e.g, cleaning or household movement, and possible self-harm attempts. To complement the PIR sensor, flex or load sensors are installed on the fan rod or on the point of mount as a measure of irregular weight alteration. These sensors can be combined to provide an accurate and timely identification of a sensor system that is in an emergency to minimise the false positives, resulting in an overall system that is more reliable. The control unit centralises the work of electronic systems, and it uses a microcontroller (Arduino or ESP32). The system activates the necessary actions in emergency cases as per the sensor readings and predefined threshold values. The microcontroller receives the input information, decides on the correct response and sets the activation of the mechanical, alarm and information communication modules. This centrality will ensure quality working and the effective interconnection of different parts of the system.

Activation of the trigger is done by the detection of abnormal load or activity. The motorised/spring-loaded descending system is invoked to relieve the pressure on the neck at the right time when the alarm bell is ringing, and alerting anybody within range. In such a two-fold immediate response, both mechanical intervention is combined with an alarm warning, and this will ensure quick assistance in minimising the prevailing fatality risk.
A GSM communication block is introduced in order to offer personal security even when the user is not in a closed space. It is a module which informs the predefined emergency contacts or caregivers using SMS alerts with real-time information about the nature of the incident and the location of the fan. This external notification system is a complete safety system based on the combination of the mechanical, electronic and communication systems, as well as represents a chance of interfering in time even when the members of the house are not present.
Finally, there is a unification of power control and safety controls in order to ensure that the systems run effectively. In case it activates, a manual override may be used to get the mechanism running again, and when all is going well, surge protection and fail-safe mechanical locking may be used to have the fans running normally in case no unusual load is present. This system is put into fierce experimentation for confirmation in long-term balancing to identify how all modules (i.e. sensor detecting, mechanical lowering, and GSM alerting) operate and how reliable they are. A test of the system in other environmental conditions will make sure that the system will be accurate and safe in the real implementation.

A. Hardware Implementation

The innovative system uses mechanical, electronic, and alarm systems to guarantee prompt and efficient emergency interventions. The key mechanical element in this system is a linear actuator, which moves in response to a sensed load if that exceeds the preset critical value. When the actuator activates, it stretches or contracts a spring-loaded rod system to instantly release or alleviate the applied pressure. This mechanical process serves as the initial and most efficient safeguard against suicide attempts through strangulation. Moreover, an alarm system with a buzzer has been integrated into the proposed system for notifying users in case of unusual weight or movement. If the system detects any strange movements or activities, the buzzer sounds a continuous and high-frequency alert. It is connected to the microcontroller and works simultaneously with the actuator to deliver efficient emergency interventions. Additionally, an LCD display system is integrated into this system to aid in monitoring and debugging processes. It gives users up-to-date data regarding sensor measurements, status of actuators, and alert conditions of the GSM module, which helps increase the transparency and usefulness of the system. While it does not play any direct role in handling emergencies, LCD plays an important role in checking and monitoring the functionality and calibration of the system. Overall, the combination of sensors, controls, mechanical actions, and alerts makes up for a multi-level safety mechanism.

B. PIR Sensor (Passive Infrared Sensor)

A passive infrared (PIR) sensor shown in Fig. 3 works on the principle of identifying changes in the amount of infrared radiation produced by human bodies, and thus, the system is able to detect the presence of people around the ceiling fan with a lot of accuracy. A review of the previous literature confirms the efficiency of PIR technology in detecting abnormal behaviours and differentiating normal household dynamics and unusual behavioural patterns. This functionality is essential in distinguishing between cleaning a user and the adjustment of the fan, or a potentially dangerous state that has caused a signal to be created, which is life-threatening in the event of an impending system failure. This kind of sensor-based discrimination would increase the intelligence and reliability of the suicide-prevention devices.

Figure 3: PIR Sensor

C. Load Sensor

A load sensor shown in Fig. 4 is a critical safety feature in a novel ceiling fan suicidal prevention device since it constantly measures the load applied to the fan by weight or excessive tension. In case the sensor identifies an abnormal load that denotes one of the potential self-harm attempts, it automatically causes an immediate response of stopping the rotary motion of the fan, sending an alert, or automatically cutting off. Such fast detection and reaction will eliminate any fatal incidents, and the ceiling fan will be much safer without any impact on the normal working of the ceiling fan.

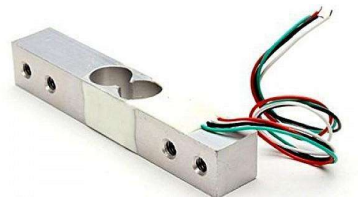

Figure 4: Load Sensor

D. GSM Module

The GSM component shown in Fig. 5 is the communication backbone of the emergency-alert subsystem, as it is used to send real-time distress messages to registered relatives, caregivers, or local emergency services. In the event that abnormal conditions are detected, the module immediately sends SMS alerts with the event description, and this would reduce the gap in responding to the situation and enhance successful recovery.

Figure 5: GSM Module

E. Arduino uno

Arduino Uno is a central processing unit, which reads sensor data, processes logic of decisions, and implements safety measures. Research on embedded-systems points out the advantages of microcontroller-based intelligence, to handle multi sensors inputs and create multiple mechanical or communication outputs with very low latency. The microcontroller in this project is constantly comparing the readings of the PIR and flex sensors, switching on the motorised separation system in case dangerous weight is detected, sounding the buzzer, and triggering GSM delays. This integrative coordination makes sure that all sub-systems will react in harmony, which is a wise way of converting a raw sensor input into a life-saving, accurate action.

F. DC motor

The DC motor shown in Fig. 6 is used in an innovative ceiling fan-based suicide prevention system to provide controlled and automatic movement. When abnormal weight or pressure is detected, the motor activates to lower or release the fan mechanism, reducing tension and preventing harm. It converts electrical energy into mechanical action, enabling a quick safety response. This makes the system reliable, smart, and helpful in protecting human life.

Figure 6: DC motor

IV. Results and Discussion

The Smart Anti-Suicide Ceiling Fan system has successfully incorporated mechanical, electronic, and embedded programming technologies to offer an efficient preventive measure against hanging accidents. Sensors are used mainly in the detection of any unusual condition through detecting changes in weight and occupancy status using PIR sensors. These sensors are attached to the ceiling fan and have their interface with the Arduino Uno board, as depicted in Fig. 7. When the sensors sense any unusual condition such as excessive force applied to the ceiling fan exceeding the set weight, the microcontroller activates a mechanism to bring down the fan or release some tension from the fan by lowering it to about 20-30cm height. Thus, the fan will not exert any pressure on the neck or cause suspension, which helps prevent deadly results of hanging.

Furthermore, an alarm system is incorporated to sound a loud buzz, and hence anyone nearby can intervene promptly. Also, the GSM module sends text messages to the defined numbers to raise alarms in case of any unusual activity. Such complementary modules like the LCD screen ensure that information related to the parameters of the system, sensors, and other vital information is provided in real time. The relay unit enables controlled switching of electronic devices in the system.

The proposed system utilizes minimal power and is highly reliable, thus ensuring its continuous operation in household settings. Importantly, the proposed system provides an effective safety solution by incorporating several safety mechanisms into one comprehensive structure. Such aspects include early detection, instantaneous mechanical reaction and audio warnings. Thus, it guarantees quick action and ensures safety and reliability of the ceiling fans.

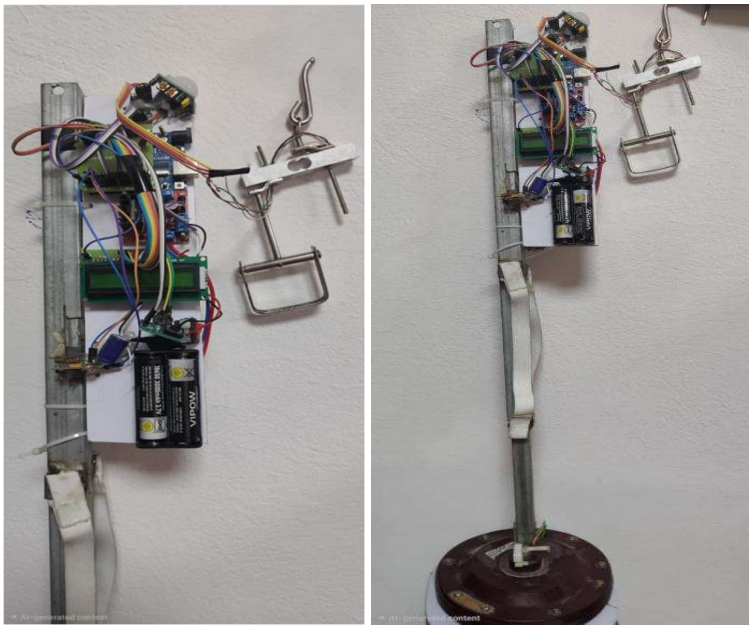

Figure 7: Prototype of the Proposed Model

V. Conclusions

This project develops a smart ceiling fan which prevents suicide attempts with the help of sensors, motors, and signals. The fan will be able to sense the abnormal weight and human presence, and it will lower itself safely and send real-time messages to the family or caregivers. Alarms draw the attention of people in the vicinity. Experimentation has demonstrated that sensors, mechanical mechanisms and GSM alerts cooperate effectively to avoid damage. It is a user-friendly system that does not interfere with the daily use of the fans since it is cost-effective and very easy to install. In general, it is a mix of the simplicity of engineering and smart technology that helps to save human lives. With such a combination of artificially created protective measures and a smart form of surveillance, the system proves to have a high potential as a preventative measure intended to save the lives and strengthen the efforts that have been taken by the community to fight suicidal tendencies at the community-wide level.

REFERENCES

[1] V. Rao et al., "Smart Home–Integrated Safety Mechanisms for Suicide Prevention," International Conference on Smart Healthcare Systems, 2025.

[2] R. N. Chatterjee et al., "IoT-Assisted Emergency Response Systems for At-Risk Individuals," International Journal of Internet of Things and Applications, 2025.

[3] P. Mukherjee et al., "Design of Load-Sensitive Mechanical Safety Devices for Household Installations," IEEE International Conference on Consumer Electronics (ICCE), 2025.

[4] S. L. Thakur et al., "Automated Alerting Systems Using GSM Technology for Health Emergencies," Journal of Healthcare Engineering, 2024.

[5] B. R. Suneja et al., "Sensor-Based Human Activity Monitoring for Safety Applications," Sensors, vol. 24, no. 3, 2024.

[6] A. R. Kannan et al., "PIR and Flex Sensor Fusion Techniques for Abnormal Motion Detection," Measurement: Sensors, 2024.

[7] D. A. Kutty et al., "Development of Mechanical Fail-Safe Mechanisms in Domestic Appliances," International Conference on Advances in Mechanical Engineering, 2024.

[8] M. R. Pradhan et al., "Microcontroller-Based Risk-Mitigation Systems in Residential Environments," IEEE Sensors Journal, vol. 23, no. 8, 2023.

[9] T. P. Nanduri et al., "IoT-Enabled Safety Architecture for Smart Homes," International Conference on Embedded Systems and Applications, 2023.

[10] R. K. Pillai et al., "Human-Centric Emergency Signaling Frameworks Using GSM Modules," International Conference on Communication Systems and Networks (COMSNETS), 2023.

[11] K. S. Reddy et al., "Intelligent Wearable Systems for Real-Time Health and Safety Monitoring," IEEE Access, vol. 13, 2025.

[12] L. Zhang et al., "AI-Driven Anomaly Detection in Smart Living Environments," Future Generation Computer Systems, 2025.

[13] A. K. Verma et al., "Embedded Systems for Emergency Detection and Response in Smart Homes," International Conference on Embedded Systems, 2024.

[14] J. P. Singh et al., "Smart Sensor Networks for Human Safety Monitoring Applications," Sensors, vol. 24, 2024.

[15] N. Sharma et al., "Design and Implementation of IoT-Based Alert Systems for Critical Situations," International Journal of Electronics and Communication Engineering, 2024.

[16] S. Gupta et al., "Multi-Sensor Fusion Techniques for Human Activity Recognition," IEEE International Conference on Signal Processing and Communication, 2024.

[17] R. Das et al., "Low-Cost Microcontroller-Based Safety Devices for Domestic Use," IEEE Transactions on Consumer Electronics, vol. 69, no. 2, 2023.

[18] P. K. Mishra et al., "GSM-Based Remote Health Monitoring and Emergency Alert Systems," International Journal of Mobile Communications, 2023.

[19] V. K. Patel et al., "Smart Home Automation with Integrated Safety and Security Features," ACM Transactions on Internet of Things, 2023.

[20] H. Ali et al., "Real-Time Risk Detection and Notification Systems Using IoT Technologies," Procedia Computer Science, 2023.