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Innovative Ceiling Fan-Based Suicide Prevention System: Review

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Abstract: *Suicide prevention is a critical public health concern, with hanging from ceiling fans being a prevalent method in such cases. This project proposes an innovative solution through the development of a ceiling fan equipped with a spring-loaded rod mechanism. Upon detecting the weight of an individual attempting to hang, the rod extends automatically to reduce pressure on the neck, thereby preventing asphyxiation. Additionally, the system incorporates an integrated alarm that promptly notifies family members or nearby individuals, enabling immediate intervention. Designed to be cost-effective, unobtrusive, and easily installable, this solution combines advanced mechanical engineering with automated alert systems to address suicide prevention effectively. By offering a proactive and practical approach, this project aims to reduce fatalities and provide timely support during critical situations.*

Keywords: Suicide prevention, Public health concern, Asphyxiation prevention, Fatality reduction

I. INTRODUCTION

Hanging is one of the leading causes of death globally, accounting for over a million deaths annually. In India, it is the second most common method of suicide after poisoning. Over the past decade, the incidence of suicide by hanging has increased, particularly among young adults, with 71% of suicides in India involving individuals under the age of 44 [1-20]. Hanging is also a prevalent method of suicide in several other countries [21-32]. A study conducted at Sir Salimullah Medical College (SSMC) from January 2000 to December 2004 examined 312 cases of suicidal hanging [33-54]. The most commonly used ligature material was rope (28%), followed by 'dupatta' (22%). Soft ligature materials were used in 68% of cases, while hard materials were involved in 5% [55-76]. Preventing suicides remains a challenging task for public health professionals, emphasizing the importance of region-specific data to identify and address factors associated with suicidal hanging[77-99].

This project aims to reduce suicide attempts involving ceiling fans by introducing a technologically advanced prevention system. The system utilizes a flex sensor to detect weight exceeding a predefined threshold. When activated, it triggers an alarm and sends a notification via GSM to designated guardians. Additionally, a spring-loaded rod integrated into the ceiling fan prevents suffocation by reducing neck pressure during an attempt. This innovative solution combines mechanical design and automated alert technology to address a critical issue, offering a practical, cost-effective, and life-saving intervention. By integrating such advancements, the project highlights a proactive approach to reducing suicides and fostering timely intervention[100-114].

II. EXPLORING THE POTENTIAL OF A SUICIDE PREVENTION SYSTEM

Suicide prevention is a complex and multifaceted challenge, demanding innovative solutions that can reach individuals in their most vulnerable moments. While traditional methods like counseling and crisis hotlines remain crucial, new technological approaches are being explored. One such emerging area is the application of existing household fixtures, like the humble ceiling fan, to potentially detect and prevent suicide attempts[15-20].

The concept, while still in its nascent stages, revolves around integrating sensors into ceiling fans that can monitor for unusual activity indicative of a suicide attempt by hanging. These sensors could detect sudden, sustained weight on the fan, triggering an alert system that could notify designated contacts, emergency services, or initiate a pre-programmed response designed to de-escalate the situation.

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How a Ceiling Fan-Based System Might Work:

- Weight Sensors: These would be crucial for detecting upward force, indicating someone attempting to use the fan as a means of suspension.
- Motion Sensors: These could potentially differentiate between normal fan operation and erratic or unusual movements associated with an attempt.
- Impact Sensors: These could detect sudden, forceful contact that might accompany a fall or struggle.
- Alerting System: Once triggered, the system could send notifications via text message, app push notifications, or even an audible alarm.
- Pre-programmed Responses: Depending on the user's preferences, the system could also initiate calming audio, dim the lights, or connect the individual to a crisis hotline.

Potential Benefits:

- Ubiquity: Ceiling fans are common in many homes, making such a system potentially widely accessible.
- Discreetness: Unlike dedicated monitoring systems, the technology would be integrated into an existing object, reducing the potential for stigma or discomfort.
- Passive Monitoring: It can operate silently in the background, ready to intervene when necessary without actively intruding on an individual's privacy.
- Speed of Response: The system could react more quickly than traditional methods, potentially providing vital minutes that can make a difference.

Challenges and Considerations:

- Accuracy and Reliability: Ensuring the system can accurately differentiate between an actual attempt and accidental weight or movement is critical. False alarms could lead to desensitization and reduced trust in the system.
- Privacy Concerns: Integrating sensitive technology into a household object raises concerns about data security and potential misuse of the information collected.
- Ethical Considerations: The very notion of using technology to monitor individuals struggling with suicidal thoughts is ethically complex. Consent, transparency, and user autonomy must be prioritized.
- Cost and Accessibility: Ensuring the system is affordable and accessible to diverse socioeconomic groups will be paramount for equitable implementation.
- Technological Limitations: The system relies on sophisticated sensors and algorithms. Technical issues could render it ineffective, leading to a false sense of security.
- User Acceptance: People may be resistant to the idea of being monitored in their own homes, even with the best intentions. Overcoming this resistance requires open dialogue and education.

The concept of a ceiling fan-based suicide prevention system is still in its early stages of development. However, it highlights the potential of leveraging existing technologies to address the pressing issue of suicide. Further research, development, and ethical discussions are necessary before such a system can be deemed safe, effective, and ethically sound[22-45].

While not a silver bullet, a ceiling fan-based system, if implemented thoughtfully and ethically, could represent a valuable addition to the growing arsenal of tools for suicide prevention. However, it’s crucial to remember that technology should never replace human connection, empathy, and comprehensive mental healthcare. The focus should remain on creating a society where individuals feel supported, understood, and empowered to seek help when they need it most. Ultimately, the most effective suicide prevention strategy is one that combines technological innovation with compassionate and readily available mental health services[60-80].

III. PREVIOUS WORK

Suicide prevention has been a critical area of research spanning public health, psychology, and engineering. Among various methods, hanging, particularly from ceiling fans, remains a common choice due to the accessibility of fans in households. Research indicates that suicides by hanging occur rapidly, leaving little opportunity for intervention.

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Consequently, efforts have been directed toward developing prevention strategies that range from mental health interventions to physical deterrents.

[1] Existing Technologies and Methods

Traditional approaches to suicide prevention have primarily focused on psychological support, such as counseling, crisis hotlines, and therapy. While these interventions are vital, they do not directly address the physical means of suicide. Proposed physical deterrents, such as collapsible hooks and breakaway devices for hanging points, have seen limited adoption due to practical constraints, cost barriers, and a lack of public awareness.

[2] Smart Solutions and Automated Systems

Recent advancements in technology have led to the development of automated systems aimed at detecting and preventing hazardous actions. For instance, IoT-based systems with sensors and alert mechanisms are being utilized to monitor at-risk individuals. Motion and pressure detection technologies, commonly employed in elder care (e.g., fall detection systems), illustrate the potential of sensor-based interventions in harm prevention. These examples underscore the effectiveness of automated solutions in mitigating risks.

[3] Gap in Research and Innovation

Despite technological progress, there remains a significant gap in research on integrating suicide prevention mechanisms into household items like ceiling fans. Most studies have concentrated on broader behavioral and mental health interventions, with limited innovation in practical, physical safety measures. Ceiling fans, ubiquitous in households across many countries, are often overlooked as a potential hazard for suicide attempts. This gap highlights the need for easily deployable physical solutions that not only deter hanging from ceiling fans but also provide immediate notification of an attempt.

IV. PROBLEM IDENTIFIED

This project addresses the identified gap by proposing an innovative design: a spring-loaded rod integrated into the ceiling fan. This system activates upon detecting abnormal pressure, preventing suffocation by reducing neck pressure while simultaneously triggering an alarm system to alert nearby individuals. By combining mechanical safety with real-time intervention, this solution offers a novel approach that aligns with contemporary research emphasizing the importance of timely responses in suicide prevention.

The proposed solution builds on existing knowledge of automated safety systems while addressing a specific high-risk method of suicide. Its practicality, cost-effectiveness, and dual focus on deterrence and intervention position it as a significant advancement in the field of suicide prevention technology.

V. OBJECTIVE

"Innovative Ceiling Fan-Based Suicide Prevention System: A Mechanical and Sensor-Driven Approach" aims to design and develop a ceiling fan system that proactively prevents suicide attempts by integrating advanced mechanical innovations and sensor-based technologies. The key objectives of the system are as follows:

- **Detection of Suspicious Activity**: Employ advanced sensors, such as load sensors, motion detectors, or pressure sensors, to identify abnormal loads or movements indicative of a suicide attempt.
- **Activation of Preventive Mechanisms**: Incorporate mechanical safety features, such as automatic fan blade disassembly, collapsible fan structures, or mechanisms that disrupt load-bearing capacity, rendering the fan incapable of supporting a person's weight.
- **Real-Time Alert System**: Integrate a communication module to send immediate alerts to emergency contacts, caregivers, or authorities, ensuring timely intervention and assistance.
- **Dual Functionality**: Ensure the fan retains its standard operational functionality for everyday use while prioritizing user safety in all situations.
- **Promotion of Mental Health Awareness**: Contribute to reducing the stigma around mental health issues by encouraging the adoption of suicide prevention systems in households and public spaces.

This system represents a novel approach to addressing a critical public health issue by combining technological innovation with practical safety measures, ultimately aiming to save lives and foster mental health awareness.

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VI. METHODOLOGY

To design an effective suicide prevention system using a ceiling fan, it is crucial to analyze the current research and technological advancements in suicide prevention, physical deterrents, and mechanical safety systems

Suicide Prevention Techniques:

Research on suicide prevention has primarily focused on mental health care, crisis intervention strategies, and therapy. Organizations such as the World Health Organization (WHO) stress the importance of psychological support systems, suicide helplines, and community-based mental health initiatives. However, these approaches predominantly address emotional well-being and lack direct measures to physically prevent suicide attempts. Studies reveal that intervention often occurs too late, underscoring the need for systems capable of early detection and physical prevention.

Methods of Suicide and Physical Deterrents:

Hanging remains one of the most prevalent methods of suicide due to the accessibility of tools like ceiling fans in households. Attempts to mitigate this risk have included the use of breakaway hooks, collapsible ceiling structures, and systems that detect abnormal pressure or motion at potential hanging points. While collapse-resistant fans and tamper-proof fittings have been proposed, their practical adoption is limited by high costs, complexity, and specialized installation requirements, making them less suitable for everyday use in homes.

Sensor-Based Intervention Technologies:

Advances in sensor-based technologies have shown success in harm prevention across various domains. For example, fall detection systems for the elderly and motion-triggered alarms effectively alert caregivers to emergencies. Systems employing pressure, motion, or weight sensors provide real-time tracking and notifications, as seen in wearable health monitoring devices and environmental sensors in smart homes. However, limited research exists on applying these technologies to prevent suicide by hanging, highlighting an area for innovation.

Emergency Alert Systems:

Emergency alert systems are widely used in personal safety applications, such as fire alarms, security systems, and health monitoring devices. Studies confirm the effectiveness of real-time notifications in mitigating risks and saving lives when timely action is taken. Despite their proven utility, integrating such alert systems into household items like ceiling fans remains underexplored, leaving a critical gap in addressing potential hazards.

Mechanical Intervention Devices:

Mechanical devices for injury and fatality prevention have been successfully implemented in industrial and household settings. Examples include automatic shutdown mechanisms in machinery and anti-fall devices for elderly care. These solutions focus on both incident prevention and immediate response. However, similar mechanical interventions targeting suicide by hanging, such as spring-loaded systems, are underdeveloped and present a significant opportunity for innovation.

Challenges and Opportunities:

Existing solutions, such as tamper-resistant ceiling fans and detachable hooks, hold promise but face barriers like high costs, lack of awareness, and complex installation processes. This creates a clear opportunity to develop accessible, affordable, and easy-to-install solutions that combine preventive measures with real-time alert mechanisms. Leveraging sensor-based technologies and mechanical interventions, such as spring-loaded systems, offers a scalable and practical approach to addressing this critical issue effectively.

This analysis highlights the need for a multidisciplinary approach that integrates mental health awareness, technological innovation, and mechanical design to create comprehensive suicide prevention solutions.

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VII. FUNCTIONALITY AND SYSTEM DESIGN

A) Functionality

The PIR sensor is utilized to detect the presence of a human, while the flex sensor identifies any added weight on the ceiling fan. A GSM module is employed to send alerts to a registered mobile number, and a motor or actuator is attached to the ceiling fan to prevent hanging attempts.

The proposed system operates as follows: Initially, all sensors remain inactive. When a person approaches the ceiling fan with the intent to hang themselves, the PIR sensor detects their presence. However, there is no immediate output since the ceiling fan might be undergoing a cleaning process. To distinguish between suicidal hanging and other activities, the flex sensor is incorporated. If a person ties a rope or material to the ceiling fan and attempts to hang, the flex sensor detects a change in resistance due to the added weight.

This change in resistance, along with the signal from the PIR sensor, is sent to the PIC16F877A microcontroller. If both inputs are active (indicating a high value), the system initiates the following actions: the motor or actuator attached to the ceiling fan moves linearly, lowering the fan so the person touches the floor, thereby preventing harm. Simultaneously, a buzzer sounds to alert nearby individuals, and the GSM module sends an emergency message to an ambulance or other relevant contacts for assistance.

To demonstrate the process and enhance understanding, an LCD display is included to show the simulation's status when conditions are met. For simulation purposes, Proteus 8 software is used to work with virtual components, while MPLAB IDE is utilized for programming the microcontroller. This tool suite supports the programming of microcontrollers such as PIC, ARM, and STM32.

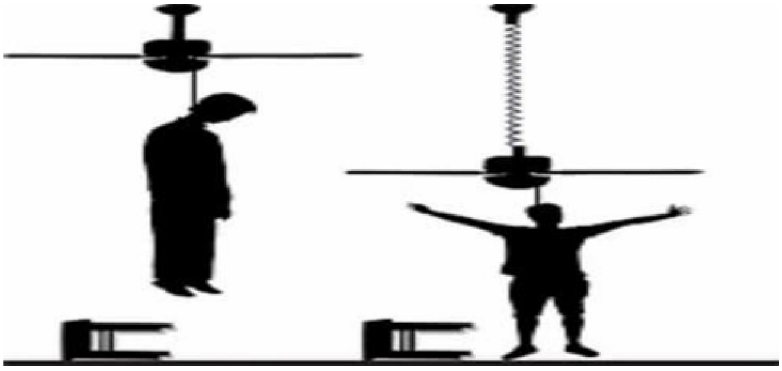

Fig 1. Model of suicide

B) System Design

The following Fig 2. Shows the Block diagram of System

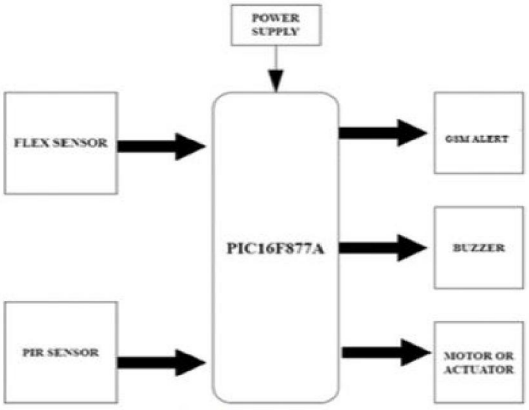

Fig.2 Block Diagram

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VIII. SYSTEM OVERVIEW: HARDWARE AND SOFTWARE COMPONENTS

The following components were used to implement the entire system

1	DC Motor
2	Single Channel Relay Module
3	9v Battery
4	LED Bulb
5	Resistor
6	PCB
7	Juck Pin
8	Ten Core Wire
9	ON/Off Switch
10	4v Charger
11	Pipe

Fig.3 Model

The Fig.3 depict a prototype or a model of a safety mechanism designed for ceiling fans to prevent hanging-related incidents. Here's an explanation based on the visible components:

1. **Frame Structure**: The model has a rectangular frame that provides support and stability for the attached components.
2. **Ceiling Fan**: A small fan is suspended in the center, representing a typical ceiling fan in a real-world scenario. This fan is connected to a motor or actuator for movement.
3. **Sensors**: The setup may include sensors such as:

- **PIR Sensor**: Detects the presence of a human near the fan.
- **Flex Sensor**: Likely placed on or near the fan blades to detect changes in resistance caused by additional weight (e.g., someone attempting to hang).

4. **Motor or Actuator**: Positioned above the fan, the motor or actuator can move the fan linearly (up or down). This movement is critical in ensuring that the fan can lower itself to make the person touch the ground, preventing harm.
5. **Control Unit and Power Source**: On the base of the model, there are visible battery packs and what appears to be a control unit. This is likely used to power the system and control the functioning of the sensors, motor, and other components.
6. **GSM Module**: Though not clearly visible in the image, a GSM module would be part of the system to send alerts to a registered mobile number in case of an emergency.
7. **Working Principle**:

- When a person approaches the fan, the PIR sensor detects their presence.
- If the person attempts to hang, the flex sensor detects the added weight.
- The system processes the signals from both sensors. If both are activated, the motor lowers the fan, and an emergency alert is sent via the GSM module. A buzzer may also activate to alert nearby individuals.

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IX. CONCLUSION

The proposed ceiling fan system, equipped with a spring-loaded rod and an integrated alarm, presents an innovative approach to suicide prevention by hanging. This system provides a practical, affordable, and easily installable solution to address one of the most common suicide methods. It ensures swift intervention by preventing neck compression and activating an audible alarm to alert nearby individuals, thereby enhancing household safety. While specifically targeting this method of suicide, the system marks a significant advancement in physical suicide prevention measures, complementing existing psychological and medical approaches. Its combination of mechanical design and sensor-based alert mechanisms offers a timely and effective solution with the potential to save lives.

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