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NAAC Accredited Autonomous Institution
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Thalavapalayam, Karur - 639 113, TAMILNADU.

A Minor Project III Report

on

AUTOMATIC FAULT DETECTION IN ELECTRICAL APPLIANCES USING AI

Submitted by

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M.KUMARASAMY COLLEGE OF ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this Report titled **"AUTOMATIC FAULT DETECTION IN ELECTRICAL APPLIANCES USING AI",** is the bonafied work of **N PALANIAPPAN(927622BEE080), T PRAVEENA (927622BEE084), M SANJANAA SHRI(9276BEE096)** who carried out the work during the academic year (2024-2025) under my supervision. Certified further that to the best of my knowledge the work reported here in does not form part of any other project report.

SIGNATURE	**SIGNATURE**
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Mrs.S.Kiruthika M.E.,	Dr.J.Uma M.E.,PhD.,
Assistant Professor	Professor & Head
Department of Electrical and	Department of Electrical and
Electronics Engineering	Electronics Engineering
M. Kumarasamy College of	M. Kumarasamy College of
Engineering, Karur.	Engineering, Karur.

Submitted for minor project III (18EEP301) viva voce Examination held at M.Kumarasamy college of Enginneering,Karur – 639113 on …………………

DECLARATION

We affirm that the Minor Project report titled "**AUTOMATIC FAULT DETECTION IN ELECTRICAL APPLIANCES USING AI"** being submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical and Electronics Engineering** is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produces mart technocrats with empirical knowledge who can surmount the global Challenges.
- ✓ Create a diverse, fully engaged, learner-centric campus environment to provide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highlycompetent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers.
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning for their success in the chosen career.

PROGRAMME OUTCOMES (POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions: Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Applythe basic concepts of mathematics and science to analyses and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real-world problems.

Abstract (Key Words)	**Mapping of POs and PSOs**
Automatic Fault Detection Artificial Intelligence Anomaly Detection Predictive Maintenance	PO1,PO2,PO3,PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12,POS1,POS2,POS3

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ABSTRACT

The recent surge in the evolution of artificial intelligence (AI) has seen the electrical engineering sector take great strides, more specifically in the area of appliances fault detection . Old habits die hard- undue reliance for the manual diagnosis is still present in many of the repair shops which is usually slow, expensive and error-prone. To the contrary the AI assisted automated systems use pattern recognition techniques to predict and identify faults in real time in a faster, precise and reliable manner. The Work examines the development and the application of a system capable of automatic fault detection of electric appliances with the use of AI technologies. The system incorporates integrated sensors into its components to track voltage, current, temperature and even vibration values across the system. Eventually, all these parameters are analyzed and processed through models to identify the presence of an anomaly indicating a fault. The system is also self-teaching as it learns from the timely recorded data practices improving upon its accuracy. The neural networks and other advanced techniques in deep learning may be useful in detecting the fault patterns which the rule based systems are incapable of handling. With this AI system, the user and the maintenance workers receive instant notification reducing the downtime by offering the repairs before serious damage occurs. This version integrates points on scalability, cost and energy efficiency, and IoT integration into the abstract for a more detailed overview of the system's benefits.

PROBLEM IDENTIFICATION

The Automatic Fault Detection in Electrical Appliances using AI addresses several critical problems. Electrical appliances frequently experience malfunctions due to wear and tear, voltage fluctuations, and component degradation, leading to breakdowns that disrupt usage. Current maintenance practices often rely on manual inspections, resulting in delayed fault detection that can exacerbate minor issues into significant problems, increasing repair costs. Additionally, undetected electrical faults pose serious safety hazards, such as overheating and electrical fires, putting users and property at risk. Reactive maintenance tends to be more expensive than proactive measures, with frequent breakdowns leading to heightened labor and parts costs, along with potential productivity losses. Many existing systems lack continuous performance monitoring, making it challenging to identify trends indicating impending failures. Furthermore, without intelligent data analysis, the sheer volume of information generated by sensors can overwhelm users, obscuring actionable insights. Implementing an AI-driven fault detection system can mitigate these issues by enabling real-time monitoring, providing immediate alerts, facilitating predictive maintenance, and enhancing safety through timely interventions.

CHAPTER 1

LITERATURE REVIEW

This chapter says about the projects and their inferences which are related to the "**AUTOMATIC FAULT DETECTION IN ELECTRICAL APPLIANCES USING AI**".

Paper 1: Fault Detection and Diagnosis Encyclopedia for Building Systems: A Systematic Review (2022)

Inference:

The paper "Fault Detection and Diagnosis Encyclopaedia for Building Systems: A Systematic Review" provides a comprehensive examination of the methodologies and advancements in fault detection and diagnosis (FDD) specific to building systems. Additionally, the paper explores the growing role of data-driven approaches to analyze operational data for fault identification, showcasing their effectiveness in recognizing patterns and anomalies.

Paper 2: Review of Fault Detection and Diagnosis Feature (2021)

Inference:

Paper titled "Review of Fault Detection and Diagnosis Feature" enunciates a detailed discussion on the various features and methodologies put to use in FDD in various applications or sectors, especially industrial and building environments. In fact, critical fault detection and its timely execution are momentous for maintaining operational efficiency and low cost in regard to equipment failure. Comparing various FDD techniques, that apply both traditional rule-based methodologies as well as model-based and advanced data-driven approaches related to machine learning and artificial intelligence.

Paper 3: Artificial intelligence-based fault detection and diagnosis methods for building energy systems: Advantages, challenges and the future (2019)

Inference:

The paper "Artificial Intelligence-Based Fault Detection and Diagnosis Methods for Building Energy Systems: Advantages, Challenges and the Future" provides an elaborate review on the application of artificial intelligence techniques in fault detection and diagnosis in building energy systems. They base the paper on a detailed set of benefits for the use of AI, which include increased precision and effectiveness in processing large amounts of data in real time, both issues critical in optimizing energy performance in buildings.

Paper 4: A review of computing-based automated fault detection and diagnosis of heating, ventilation, and air conditioning systems (2022)

Inference:

The paper "A Review of Computing-Based Automated Fault Detection and Diagnosis of Heating, Ventilation, and Air Conditioning Systems" makes a detailed analysis regarding the progress of automated fault detection and diagnosis specifically for HVAC systems. Differences in computing-based methodologies applied for maximizing the efficiency and reliability of HVAC operations are discussed. Overall, this paper is a good source of information about the current state and potential of FDD methods automated in HVAC systems, stressing the importance of computing technologies in building performance and sustainability.

Paper 5: Automated Fault Detection HVAC (2017)

Experimentation through the research efficiently demonstrates the effectiveness of this method. Here, dramatic improvement has been found in detection accuracy in comparison to the conventional methods. In addition, the authors describe the future implications of their study with regard to HVAC system monitoring and relate deep learning techniques to revolutionize the automated fault detection and diagnosis methodology in building energy systems.

CHAPTER 2

PROPOSED METHODOLOGY

2.1 BLOCK DIAGRAM:

This chapter brings about the proposed methodology of the **“AUTOMATIC FAULT DETECTION IN ELECTRICAL APPLIANCES USING AI”** project.

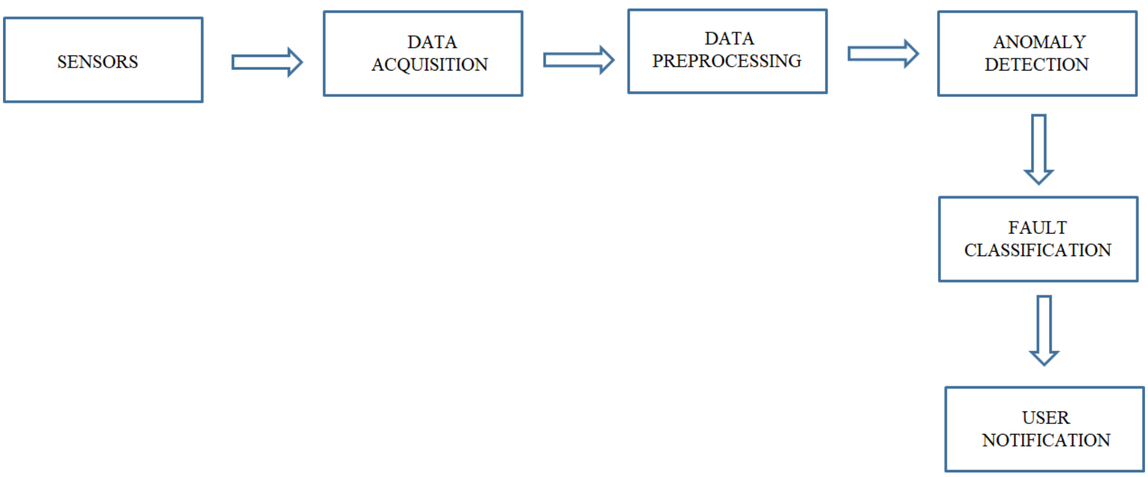

Figure.2.1

2.2 DESCRIPTION:

2.2.1 TRANSFORMER:

Figure.2.2.1

An **electrical transformer** is a device that transfers electrical energy between two or more circuits through electromagnetic induction. It's commonly used to increase or decrease the voltage of alternating current (AC) in power systems.

2.2.2 VOLTAGE SENSOR:

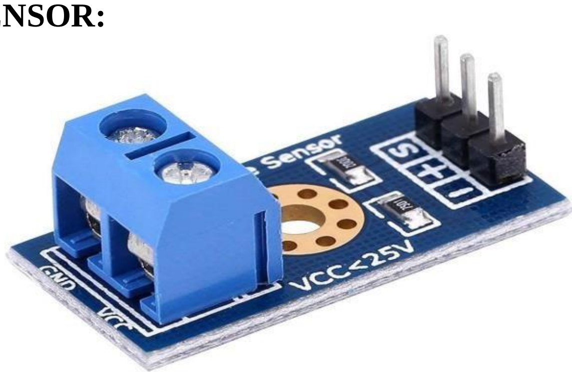

Figure.2.2.2

A voltage sensor measures the voltage level in an electrical circuit and can detect abnormalities like fluctuations, spikes, or drops. For fault detection in electrical appliances, it's useful in identifying potential issues before they cause damage.

2.2.3 TEMPERATURE SENSOR:

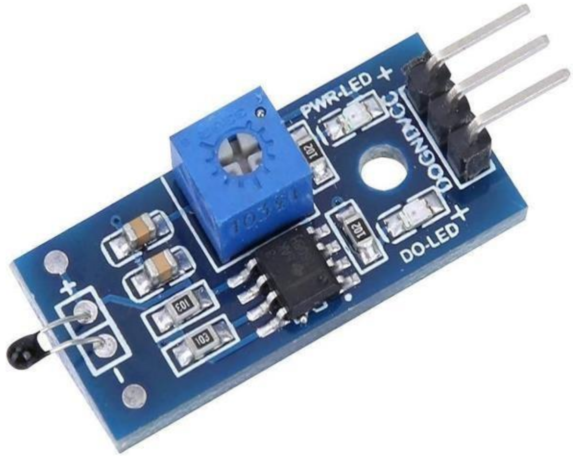

Figure.2.2.3

Their primary purpose is to measure temperature changes in appliances, equipment, or environments, detecting abnormal increases to prevent damage or failure. By monitoring temperature, these sensors enable thermal management, regulating temperature to maintain optimal performance and efficiency.

2.2.4 COMMUNICATION MODULE:

Figure.2.2.4

Data transmission from sensors to a central unit, cloud, or user interface requires a communication module in a Automatic Fault Detection System for Electrical Appliances utilizing AI. The range and connectivity requirements determine which module is best. Wi-Fi modules that offer high data rates and simple cloud connectivity, such as ESP8266 or ESP32, are perfect for Internet of Things applications running on a network.

2.2.5 RELAY MODULE:

Figure.2.2.5

A **Relay Module** is an electrical switch that allows a microcontroller or processor to control high-power appliances safely. In an **Automatic Fault Detection System for Electrical Appliances using AI**, a relay module is essential to cut off power to an appliance in case of fault detection, helping to prevent damage or hazards.

2.2.6 MICROCONTROLLER:

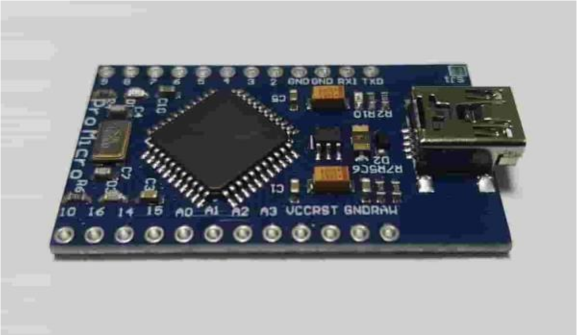

Figure.2.2.6

A **Microcontroller** is the core component in an **Automatic Fault Detection System for Electrical Appliances using AI**, as it handles data acquisition, processing, and communication. It interfaces with sensors to monitor parameters like voltage, current, and temperature and can send fault alerts or

2.3 COST ESTIMATION:

S.NO	COMPONENT	QUANTITY	COST
1	Microcontroller	1	800
2	Temperature Sensor	1	100
3	Current Sensor	1	200
4	Voltage Sensor	1	240
5	Relay Module	1	130
6	Wires	As per required	10
		TOTAL	**1480**

CHAPTER 3

RESULT AND DISCUSSION

Electrical appliances have increasingly improved in accuracy, efficiency, and quick responsiveness compared to the use of traditional methods since the introduction of AI-based automatic fault detection systems. For instance, machine learning algorithms, particularly neural networks, are very effective in anomaly detection through evaluation of different operational parameters like voltage, current, temperature, and vibration. Further, artificial intelligence systems are learnable from historical data so that the performance in terms of fault diagnosis can be enhanced continuously. The employment of self-learning algorithms affords adaptability to new fault patterns that were previously unknown, providing for a much more robust diagnostic tool. The other benefits underscored are real-time notifications to users and maintenance staff, which reduces downtime and permits proactive maintenance.

The application of AI in fault detection and diagnosis has brought about a paradigm shift in how electrical appliances are monitored and maintained. One of the primary advantages of using AI is the reduction in human error associated with manual diagnostics, which is often slow and costly. With AI, fault detection can occur in real-time, allowing for immediate action and minimizing the risk of severe damage to appliances.

In conclusion, AI automatic fault-detecting systems in electrical appliances show significant advancements compared with traditional approaches and have brought about new problems that need to be addressed so these systems are widely applied in the industry. Further research work and development are required to fine-tune these systems so they will meet the needs of the users and improve the reliability of electrical appliances.

CHAPTER 4

CONCLUSION

In conclusion, it means that the use of AI in automatic fault detection of electrical appliances is the latest invention in appliance technology. Through machine learning and IoT, predictive maintenance may become efficient in optimizing energy efficiency as well as enhancing the user's safety through real-time monitoring and self-diagnosis capabilities. Hurdles like quality data, cost, and security notwithstanding, the benefits prevail over the drawbacks. This means when the next generation of consumer demand for smarter, more efficient appliances is explored, the integration of AI into fault detection will not only change appliance performance but lead to a more sustainable and user-friendly approach toward household management. The current trend inthis development field is going to set a new bar in reliability and efficiency from electrical appliances toward quality living. The integration of AI for automatic fault detection in electrical appliances is set to revolutionize the way we interact with and maintain our household devices. This technology promises to enhance predictive maintenance, allowing appliances to self-diagnose issues and provide real-time alerts, thereby minimizing downtime and reducing repair costs. As appliances become increasingly connected through IoT, users will benefit from improved safety and efficiency, along with tailored maintenance recommendations based on their usage patterns. Although challenges like data integrity, cost implications, and security concerns must be addressed, the potential for smarter, more reliable appliances is immense. Ultimately, the future of electrical appliances lies in harnessing AI, leading to a more efficient, sustainable, and user-centric approach to home management.

CHAPTER 5

FUTURE SCOPE AND IMPLEMENTATION

Much future potential can be envisioned in automatic fault detection for electrical appliances, what with advancements related to predictive maintenance, real-time monitoring, and self-diagnosis. Through IoT integration, appliances will continuously monitor performance, thus this will immediately alert for faults and enhance the safety of the user. Efficiency through appliances can be optimized by AI since it will detect inefficiencies in operations and give specific guidelines for maintenance, keeping the vision at the level of user behavior. Data collection is seen through sensors, machine learning algorithms in anomalies, and robust IoT connectivity for monitoring appliances over the internet with remote functionalities. Friendly interfaces will provide diagnostic results while further comprehensive testing is required with rigid compliance with safety standards for widespread acceptance. Data quality, costs, security, and user acceptance remain some of the biggest challenges in the evolution of AI in fault detection. The future promises smarter, more reliable appliances that bring high efficiency to boost the use of appliances with great value.

Some aspects of Future Scope:

- Integration of AI Algorithms
- Predictive Maintenance
- User Centric Interfaces
- IoT Integration

IMPLEMENTATION:

Implementing an Automatic Fault Detection System for Electrical Appliances using AI involves a structured approach that begins with project planning and requirements analysis, where clear objectives are defined, specific appliances to monitor are identified, and functional and non-functional requirements are documented. The next step is system design, which includes creating a high-level architecture diagram that outlines components such as sensors, microcontrollers, communication modules, and AI processing units. Hardware components are then selected, followed by data acquisition and sensor integration, where sensors are installed and calibrated to accurately measure parameters like voltage and current.

Once the sensors are integrated with the microcontroller, data processing and AI model development commence, involving data collection, preprocessing, and training of the chosen machine learning algorithms. Communication module implementation follows, where the selected protocol (Wi-Fi, Bluetooth, or GSM) is set up to enable real-time alerts to users. A user interface is developed, either as a mobile or web application, to display appliance status, fault alerts, and performance trends, along with features that allow user interaction for appliance control.

Thorough testing and validation of the system are crucial, including unit and integration testing as well as fault simulation to assess the AI model's performance. Once tested, the system is deployed in a real-world environment, ensuring proper installation of sensors and connectivity. User training is provided to facilitate operation and interpretation of alerts. Finally, ongoing monitoring and maintenance are essential to continuously assess system performance and implement improvements based on user feedback, ensuring the system remains effective and reliable.

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