ANN-NS OPTIMIZATION ALGORITHM-BASED SMART POWER GENERATION SYSTEM USING PIEZOELECTRIC ON IOT FOR SMART CITIES

ATRIA INSTITUTE OF TECHNOLOGY

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Keywords:

- ANN Optimization
- Piezoelectric Sensors
- Smart Power Generation
- Green Energy
- Street Light System
- Vehicle Movement
- Arduino Board

Introduction:

This is a IOT project based on electricity generation from kinetic energy. The materials used in the project are Piezoelectric Sensors, IR Sensors, LED's, Battery, and Micro Controller (Arduino UNO Micro Controller). This pressure plates i.e., Piezoelectric Sensors works when any kind of pressure applied on these. Our project works on the same principle, we will be installing these plates on roadways, highways, subways, expressways, and footpaths also. These falling pressure from the vehicles and human feet generates an enormous amount of kinetic energy. The mechanism of converting Kinetic Energy into Electrical Energy which are used in rotor shafts are used here. Piezoelectric sensors placed on the surface of roads which will convert pressure into electrical energy. Power and energy are currently among the most

essential demands of the modern world. The intention of this work is to generate electricity from the pressure in a non-conventional way and store in a battery to use in various purposes. This project consists of electricity generation using the pressure plates. The pressure plates are installed on the road through which when any vehicle passes it generates a numerous amount of electricity which can be used for streetlamps and roadside vendors.

The major goal of installing automatic streetlights is to ensure that they only turn on fully when there are vehicles or pedestrians on the road and charge up the battery to ensure that the lamps keep glowing without the support of electricity supplied from the board. The electrical energy produced by the pressure exerted by people and automobiles falling on piezoelectric plates to be converted into electrical energy and can be used to power streetlights. Hence, we do not need to independently supply electricity to the streetlights. The streetlamp comprises of IR sensors, piezoelectric sensors, Wi-Fi-modules, and Arduino sensors are all included in the autonomous system.

Objective:

This is a IOT project based on electricity generation from kinetic energy. This pressure plates i.e., Piezoelectric Sensors works when any kind of pressure applied on these.

Our project works on the same principle, we will be installing these plates on roadways, highways, subways, expressways, and footpaths. These falling pressure from the vehicles and here Piezoelectric sensors placed on the surface of roads which will convert pressure into electrical energy.

Nowadays energy and power are one of the most basic needs of the modern world. The intention of this work is to generate electricity from the pressure in a non-conventional way and store in a battery to use in various purposes.

Whenever force is applied on piezoelectric sensors that force is converted into electric energy. Here, the pressure is taken as an input and is converted into electric energy and stored into chargeable batteries.

The intention of this work is to generate electricity from the pressure a non-conventional way and store in a battery to use in various purposes. The systems are designed in such a way that it can be used for glowing the streetlamps and LED board.

The piezoelectric sensors till then send signal into the Arduino UNO and transform it into electric energy.

Methodology:

- Module 1: Generation of electricity with the help of piezo sensors
- Module 2: Arduino implementation
- Module 3: Application Spark arc developed.

Generation of electricity with the help of piezoelectric sensors:

A device known as a piezoelectric sensor makes advantage of the piezoelectric effect to transform changes in pressure, acceleration, temperature, strain, or force into an electrical

charge. A proportional voltage source and filter network can be used to represent a piezoelectric transducer's extremely high DC output impedance. The force, pressure, or strain that is delivered directly proportionally affects the voltage V at the source. This mechanical force is then connected to the output signal as if it had travelled through the equivalent circuit.

Arduino implementation:

The accessible Arduino platform is used to create electrical projects. Using Arduino, users can write and upload computer code toa circuit board (often referred circuit board (commonly called a microcontroller) using a piece of software called the IDE (Integrated Development Environment), which is running on user's computer.

Application Spark arc development:

This application is based on the data collection from the Arduino to calculate the electricity. This contains a database which will have the record of electricity generated from the plates. If the electricity is not constant from any plates, then we can conclude that the plate is damaged or not functional and we can replace the plates. This application will keep the monthly records in the database of electricity generation.

Results and Conclusions:

The project "ANN-NS OPTIMIZATION ALGORITHM BASED SMART POWER GENERATION SYSTEM USING PIEZEOELECTRIC ON IOT FOR SMART CITIES" offers a sensible means of producing electricity in underdeveloped nations. As a result of the autonomous street light system being put in place, energy management will be made simple. Implementing a system of vehicle-based energy generating in rural areas will aid in resolving inhabitants' issues with the current energy crisis. Appliances powered by DC and AC will both be powered by this system. This technique can work better in busy areas. The Smart Street light system will help cut down on energy usage which will be generated for other usage of cities and buildings.

The following are the findings of an artificial neural network (ANN) and nature inspired optimisation algorithm (NS) based smart power generating system for smart cities using piezoelectric technology:

1. Enhanced Power Generation: The smart power generation system's use of ANN and NS optimisation algorithms can considerably raise the piezoelectric technology's power generation efficiency. The performance of piezoelectric devices can be optimised by intelligent optimisation algorithms, maximising their capacity for power generation and assuring effective energy harvesting from background vibrations in smart cities.
2. Real-time monitoring: Control of the system are made possible by the IoT thanks to the integration of the piezoelectric power generation system. Piezoelectric device performance, environmental factors, and energy consumption may all be tracked via sensor nodes, enabling data-driven decision-making and effective power generation management in smart cities.

3. Sustainability: Green energy and sustainability are encouraged in smart cities by the use of piezoelectric technology in the smart power generation system. Piezoelectric technology is a clean and renewable energy source because it harvests energy from background vibrations, which are common in metropolitan settings.
4. Increased Scalability and Reliability: The smart power generation system's scalability and reliability can be improved by using ANN and NS optimisation methods. According to shifting environmental factors and energy demand, the intelligent algorithms may adaptively optimise the functioning of piezoelectric devices, ensuring stable power generation and system scalability to meet various energy requirements in smart cities.

What is the innovation in the project?

The performance of an ANN-NS optimisation algorithm-based piezoelectric smart power generating system for smart cities might vary depending on a number of variables, including the calibre of the training data, the system's complexity, and the surrounding circumstances. However, the following outcomes of this system are possible:

1. Improved Energy Efficiency: By minimising energy waste and enhancing the system's overall energy efficiency, the ANN-NS optimisation method may optimise the system's performance to generate energy effectively.
2. Reliable and Sustainable Energy Source: Piezoelectric materials can be used in smart power generating systems to produce energy from environmental vibrations and movements, making them a reliable and sustainable energy source.
3. Cost savings: By delivering clean and sustainable energy to the smart city, the smart power generation system can aid in lowering energy expenditures. For the city and its citizens, this may result in cost savings.
4. Scalability: The smart power generating system is a flexible option for energy generation because it is simple to scale it up or down depending on the energy needs of the smart city.
5. Real-time monitoring and control: The deployment of IoT devices can offer data on the system's performance in real-time, enabling ongoing monitoring and control of the system. As a result, the system's dependability and effectiveness may increase.

Overall, the smart power generation system for smart cities based on the ANN-NS optimisation algorithm and employing piezoelectric technology on the Internet of Things has the potential to offer a dependable, environmentally friendly, and economically advantageous source of energy. The performance of the system may be improved, and by integrating it with other smart city technologies, it can contribute to the development of a more sustainable and effective urban environment.

It has a interconnected set of components like Piezoelectric sensor plates, rely, rechargeable batteries, Arduino board, lcd display etc. where pressure will be given on the piezoelectric sensor plates by the movement of the vehicle, and it will be generating electricity which will gets stored in the rechargeable battery. The project is connected

with the blynk application to the display how voltage is generated and stored in the battery. Also, to visualize data in the blynk app the component rely will be functioning to store data in database.

Scope of Future Work:

1. Advanced optimization algorithms: The proposed Chick Whale optimization algorithm can be further improved or combined with other nature-inspired or metaheuristic algorithms to enhance its performance. For example, incorporating techniques like hybrid algorithms or machine learning algorithms could potentially result in more efficient and effective VM migration strategies in cloud computing environments.
2. Extended objective functions: The current research considers load, resource availability, energy consumption, migration cost, and power consumption as the optimization objectives. Future enhancements could involve incorporating additional objectives, such as security, reliability, scalability, or environmental sustainability, to provide a more comprehensive and holistic approach to VM migration decision-making.
3. Enhanced decision-making mechanisms: The decision-making mechanism in the proposed VM migration strategy can be further refined to incorporate more sophisticated algorithms or decision rules. For instance, using fuzzy logic, expert systems, or machine learning techniques for decision-making can potentially improve the accuracy and efficiency of VM migration decisions, especially in complex and dynamic cloud computing environments.
4. Real-world implementation and evaluation: The current research is based on simulation experiments, and future enhancements could involve real-world implementation and evaluation of the proposed VM migration strategy. Conducting real-world experiments in diverse cloud computing environments with varying workloads, resource capacities, and network conditions can provide practical insights and validate the effectiveness of the proposed strategy in real-world scenarios.

PPT FOR THE PROJECT REFERENCE

ANN-NS OPTIMIZATION ALGORITHM BASED SMART POWER GENERATION SYSTEM USING PIEZOELECTRIC ON IOT FOR SMART CITIES

Project Reference No.:

ATRIA INSTITUTE OF TECHNOLOGY

INFORMATION SCIENCE AND ENGINEERING

Student(s) Name:
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2. Revati Rajkumar Naik
3. Saumya Ranjan

Guide(s) Name:
1. Mrs. Meenatchi R.

OBJECTIVES

The goals of the piezoelectric smart power generation system based on the ANN-NS Optimisation Algorithm for smart cities can be summed up as follows:

1. Sustainable Energy Generation: The system's main goal is to provide environmentally and financially sound sustainable energy. The device uses a clean and renewable source of energy thanks to the usage of piezoelectric ensors to collect energy from moving vehicles and people on foot.
2. Efficient Energy creation: The system tries to maximise energy creation by precisely anticipating the piezoelectric sensors' capacity for energy production and strategically placing them. As a result, energy is generated more effectively, with less waste and for less money.
3. Remote Monitoring and Control: The IoT technology makes it possible to remotely monitor and manage the energy producing process, which increases its management efficiency and practicality. It is quicker and more efficient to manage the system from one single location.
4. Lessened Carbon Footprint: By supplying a renewable and environmentally benign source of energy, the system seeks to lessen the carbon footprint of urban areas. Piezoelectric sensors can produce energy, which lessens the need for conventional energy sources that fuel environmental degradation and climate change.
5. Improved Energy Security: By producing energy locally and lowering reliance on outside energy sources, the system improves energy security. As a result, the system is more resistant to disturbances such as power outages.

METHODOLOGY

- The system will be designed in such a way that will generate electricity using piezoelectric sensor
- Multiple street lamps will adjoin its circuit at a single arduino which will help in calculation of electricity generated from these piezoplates using the process of ANN
- Our aim is to provide electricity supply on the street lamps.
- Our goal is to reduce the space of installation and cost of the implantation of generating clean energy

ALGORITHMS : ANN, Notification system algorithm:

- IoT-based power generation using moving vehicles to generate electricity from pressure plates has a microcontroller (Ardunio) which is connected with Piezoelectric sensors to convert Kinetic Energy into Electric Energy.
- IR sensors to detect a vehicle, Relay to turn the street lamp ON, and Wi-Fi module to connect it to applications where we can check the electricity generation from each Piezoelectric sensor and can easily replace the defective sensors.
- The entire system is also supplied with a power supply which is connected to the battery where we can store the buffer-generated electricity.

METHODOLOGY

- Module 1 : Generation of electricity with the help of pizeosensor.
- Module 2 : Ardunio implementation.
- Module 3 : Application Spark arc development.

Module 1 : Generation of electricity with the help of pizeosensor

Piezoelectric Sensor Plate

The fig. 1 shows the piezoelectric sensor plate. A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge A piezoelectric transducer has very high DC output impedance and can be modeled as a proportional voltage source and filter directly proportional to the applied force, pressure, or strain. The output signal is then related to this mechanical force as if it had passed through the equivalent circuit.

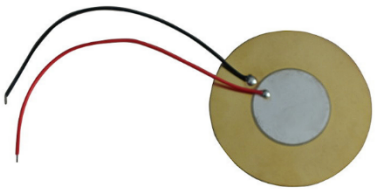


Fig. 1 PIEZOELECTRIC PLATE

METHODOLOGY

Module 2 : Ardunio implementation

Ardunio

The fig. 2 shows the Arduino UNO Board. Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

Fig. 2 Arduino UNO Board

Module 3 : Application Spark arc development.

Spark Arc Application

The fig. 3 shows the Spark Arc Application. This application is based on the data collection from the arduino to calculate the electricity. This contains a database which will have the record of electricity generated from the plates.
If the electricity is not constant from any plates then we can conclude that the plate is damaged or not functional and we can replace the plates.
This application will keep the monthly records in the database of electricity generated.

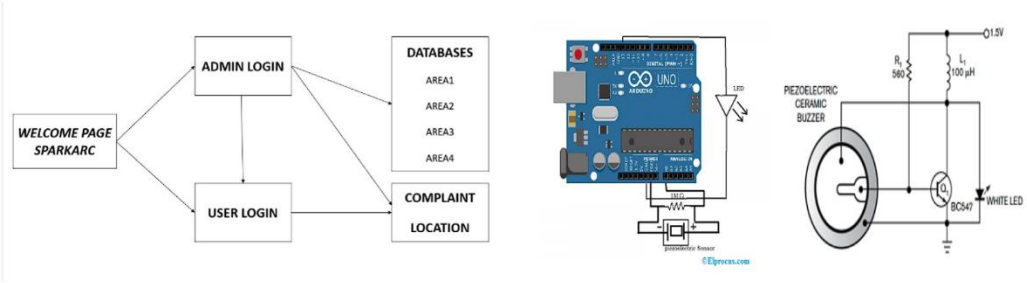
Fig. 3 Spark Arc Application

WORK PLAN

- Introduction:
  This chapter talks about the problem statement, overview of the project, purpose, itsobjectives and its applicability with its theoretical outline.
- Literature Survey:
  Gives brief overview of the paper and the research sources that have been studied toestablish through an understanding of the under consideration.
- System Requirements Specification:
  Discussed in detail about the different kind of requirement needed for project.
- System Design:
  Gives detail about timeline of the project development.
- Implementation and Testing:
  Gives the description about the algorithms and methodologies of the project.
- Results and Discussion:
  Gives the description of the working and screenshots of the project.
- Conclusion:
  Gives the description of the conclusion of the project.
- References:
  Gives the information of the journals and papers referred to develop the project.

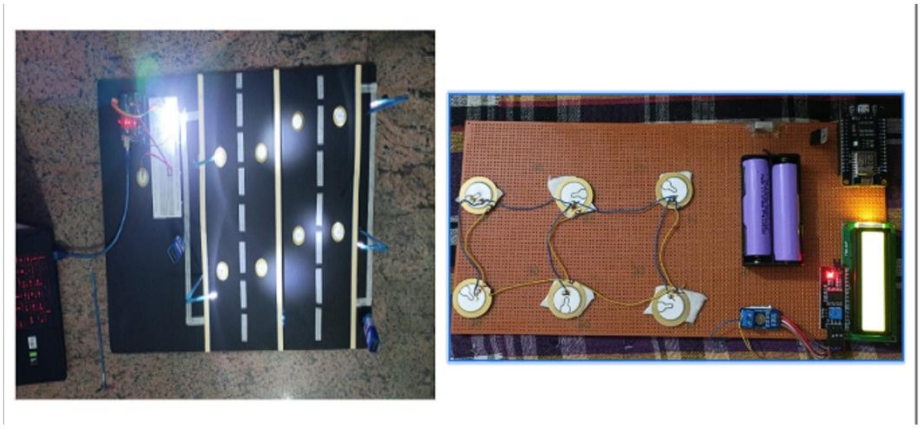
DESIGN OF IMPLEMENTATION

This is the implementation of the components and also the application of the project.



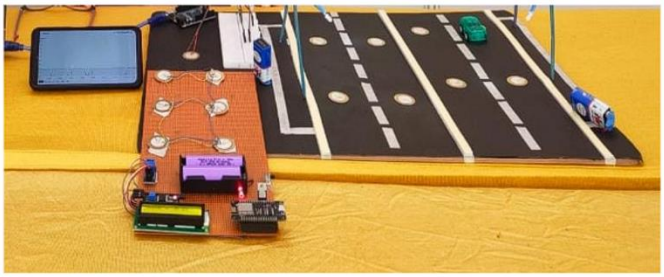
RESULTS

This is the final outcome of the project.



SCIENCE & TECHNOLOGY COMPONENT

The below figure shows the actual system design model and circuit used in the model as shown. It has a interconnected set of components like Piezoelectric sensor plates, rely, rechargeable battries, Arduino board, lcd diplay etc. where pressure will be given on the piezoelectric sensor plates by the movement of the vehicle, and it will be generating electricity which will gets stored in the rechargeable battery. The project is connected with the blynk application to the display how voltage is generated and stored in the battery. Also, to visualize data in the blynk app the component rely will be functioning to store data in database.



CONCLUSION

The following are the findings of an artificial neural network (ANN) and nature- inspired optimisation algorithm (NS) based smart power generating system for smart cities using piezoelectric technology:

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