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A Study on the Impact and Effectiveness of AI and IoT-Based Smart Park for Exercise Monitoring and Electricity

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Abstract - *Public parks offer an easily reachable setting for exercise and fitness, yet the mechanical energy that people generate on outdoor workout equipment is usually wasted. This work proposes an AI and IoT Based Smart Park for Exercise Monitoring and Electricity Generation Using RFID, a single platform that brings together outdoor exercise machines, power generation, RFID-based user recognition, IoT monitoring and AI-driven data analysis. In the proposed design, each machine is coupled to a suitable generator, so the effort a person puts in while exercising is turned into electrical energy. IoT sensors track quantities such as session time, voltage, current and the electricity produced, and the readings are saved in a central database. Registered users receive a unique RFID-based Smart Park Identity Card; tapping it on a machine's reader before a workout lets the system recognize the user and log the session together with the equipment used, its duration and the verified energy produced. Users and administrators can view this information on a monitoring dashboard. Artificial intelligence and machine learning methods can then be used to study exercise behavior, energy-generation trends and equipment performance, to flag abnormal machine behavior, and to explore tailored exercise suggestions. The system further considers whether verified energy contributions could later earn rewards or electricity-bill incentives, which would be subject to the relevant government and power-utility policies and to regulatory clearance. The study seeks to show how exercise monitoring, power generation, RFID, IoT and AI can be combined to make public parks more interactive, sustainable and driven by data.*

Keywords - Smart Park, Artificial Intelligence, Internet of Things, RFID, Exercise Monitoring, Electricity Generation, Machine Learning, Smart Fitness, Energy Monitoring

1. INTRODUCTION

Parks give communities a place to be active, unwind and socialize. Many of them include open-air exercise equipment, which lets residents work out without paying for a gym. Simply installing the equipment, however, does not ensure that it gets used regularly: how often people turn up depends on awareness, upkeep of the machines, safety, motivation and ease of access.

A second point worth noting is the mechanical energy that a person produces on such equipment. The movement and effort involved in a workout generate mechanical energy that, at present, simply dissipates. Coupling suitable machines to a generator offers a way to transform that energy into electricity.

This paper presents an AI and IoT Based Smart Park for Exercise Monitoring and Electricity Generation Using RFID. Rather than seeing open-air exercise machines purely as fitness amenities, the proposed design treats them as nodes in a connected Smart Park. Generators and IoT sensors attached to the machines can track workouts and power output, with quantities such as session time, voltage, current and generated energy being measured and logged.

RFID is proposed to recognize registered users and follow their sessions. Every registered member would hold a unique RFID-based Smart Park Identity Card, which is tapped on a reader before starting a machine. The system then recognizes the member and links the session to details like the equipment used, how long the workout lasted and the verified electricity produced. These records go into a database and can be viewed on a suitable monitoring dashboard.

An Artificial Intelligence and Machine Learning layer is also introduced to examine the data gathered by the IoT system. Whereas IoT describes what took place during a session, AI can be applied to the gathered records to reveal meaningful patterns. This layer can be explored for studying how users behave, how energy generation varies and how well equipment performs. It could also help spot abnormal equipment behavior and produce useful exercise-related suggestions.

The system can keep per-user logs of exercise and verified energy contribution, which offers a starting point for investigating future reward or incentive schemes. One possible direction is to credit verified

contributions against electricity bills. Any such benefit, though, would first need suitable policies from the government or power utility, financial arrangements and regulatory approval.

In short, the proposed Smart Park seeks to unify exercise monitoring, power generation, RFID-based identification, IoT monitoring and AI-based analysis in one system. The work examines how public exercise infrastructure can become more interactive, sustainable and data-driven, while encouraging physical activity and putting the energy generated by exercise to good use.

2. REVIEW OF LITERATURE

2.1 Adam Blechman et al. (2009) – "A Study of the Benefits of Retrofitting Cardiovascular Exercise Equipment of a Gym with Human Energy Harvesting Technology"

Blechman et al. (2009) investigated whether cardiovascular machines could be used to produce electricity. Their work centred on turning the effort of gym users into electrical energy, and it weighed the possible advantages and practicality of adding human energy-harvesting technology to gym facilities.

The work is relevant here because it backs the idea of producing electricity from exercise machines. The present study carries that idea over to public parks by adding IoT sensing, RFID-based user identification and AI-based data analysis.

2.2 Shuaishuai Wang (2021) – "Sports Training Monitoring of Energy-Saving IoT Wearable Devices Based on Energy Harvesting"

Wang (2021) examined energy-efficient wearable IoT devices that track sports training and draw power from energy harvesting. The study looked at how harvested energy could support IoT-based monitoring, collecting and processing physical-activity information, and it also covered energy management and communication methods for such connected devices.

This is relevant to the Smart Park since it links energy harvesting with IoT-based activity tracking. In a similar way, the proposed system relies on sensors to capture session time and power-generation parameters, and the stored data can be analyzed to understand exercise behavior and energy output.

2.3 Zijuan Liu, Xiulong Liu and Keqiu Li (2020) – "Deeper Exercise Monitoring for Smart Gym Using Fused RFID and CV Data"

Liu et al. (2020) described a smart-gym monitoring method that fuses Radio Frequency Identification (RFID) with computer vision (CV). They concentrated on recognizing users and tracking their exercises in a gym, including cases where several people are present, and showed that the two technologies together can support finer-grained exercise monitoring.

The work supports the RFID part of the Smart Park. Here, users tap their registered cards before using a machine, after which the system can link the user's identity to equipment use, session length and measured electricity output.

2.4 Garvit Chandna (2025) – "IoT in Smart Gym Equipment: Revolutionizing Fitness through Connected Technology"

Chandna (2025) reviewed how the Internet of Things (IoT) is used in present-day gym equipment, covering connected sensors, real-time performance tracking, equipment management and personalized fitness features. The paper pointed out that data from connected machines lets users follow their own performance and helps administrators look after the equipment.

This relates to the IoT layer of the Smart Park. Comparable technology can be fitted to outdoor machines to capture exercise and energy data, and AI and machine

learning can then be applied to that data to detect abnormal equipment behavior and examine energy-generation trends.

2.5 Douglas Yeboah and Bismark Danso Annor (2025) – "SynergyFit Energy Recovery Framework for Human-Centric Power Generation in Multi-Modal Fitness Environments"

Yeboah and Annor (2025) examined how energy can be recovered from various kinds of physical exercise. They put forward the SynergyFit Energy Recovery Framework, which takes in activities such as resistance training, cardiovascular exercise and functional training, and they looked at how exercise-related factors affect how much energy can be recovered.

This is closely tied to the Smart Park's electricity-generation goal because it supports recovering energy from human activity. The present study builds on it by adding IoT-based electricity measurement, RFID-based user identification and AI-based analysis of exercise and energy data.

2.6 Summary of Literature Review

The surveyed studies show that human physical activity can be treated as a source of electrical energy, and that IoT and RFID can support exercise monitoring and user identification. They also give grounds for looking into intelligent analysis of exercise and equipment data. Drawing on these ideas, the proposed Smart Park combines the technologies in a public-park setting. It aims to keep per-user exercise records, track electricity generation and analyze the gathered data, while laying the groundwork for assessing possible future incentives.

3. RESEARCH GAP

Earlier work has looked at harvesting human energy from exercise machines and has shown that physical activity can be turned into electricity. Other work has dealt with IoT-based tracking of fitness activity, smart exercise equipment and RFID-based user identification. These studies, however, tend to address one aspect at a time, whether energy harvesting, exercise monitoring or user identification, rather than offering a combined solution for public parks.

There is a clear gap in tying the electricity actually produced during a workout to the identified user and session in a public park. Existing research also integrates IoT-generated exercise and energy data with AI-based analysis only to a limited degree, leaving user behavior, energy-generation trends and equipment performance less well understood.

This research therefore tries to close that gap through the proposed Smart Park, which combines exercise equipment, electricity generation, IoT sensors, RFID-based user identification and AI/ML-based data analysis. Such integration can yield a per-user record of exercise and verified energy generation, forming a basis for future energy-based rewards and incentives.

3.1 Problem Statement

Public parks offer open-air exercise facilities that keep people active, but the mechanical energy produced by exercising is usually not harnessed to generate electricity. Conventional park equipment also reveals little about individual users, their sessions and the energy produced during their workouts, and neither the equipment nor the data it generates is monitored well.

The problem is thus to build a Smart Park that unites exercise equipment, power generation, IoT-based monitoring and RFID-based user identification in one environment, and that records key details such as the user, the machine used, session length and the electricity actually generated.

In addition, the collected data can be examined with AI and machine learning to uncover exercise patterns, energy-generation patterns and equipment performance. This would give a structured per-user record of exercise and verified energy, and lay the groundwork for future rewards and incentives. The research accordingly aims at an integrated, data-driven approach that makes park exercise facilities more useful, measurable and sustainable.

4. OBJECTIVES OF RESEARCH

The main objectives of this study are:

1. To build an AI and IoT based Smart Park that links outdoor exercise equipment with electricity generation and exercise monitoring.
2. To use IoT sensors and RFID-based identification to record session time, equipment use and verified electricity generation.
3. To apply AI and machine learning to examine exercise activity, energy-generation patterns and equipment performance.
4. To assess the proposed Smart Park and gauge user acceptance of exercise monitoring, electricity generation and possible future incentives by means of a structured survey.

5. HYPOTHESIS OF THE STUDY

The hypotheses below are framed to examine how public park exercise equipment is used, interest in electricity generation, acceptance of RFID-based monitoring, willingness to use the proposed Smart Park, and preferences for AI-based features and rewards. They are tested on survey responses from 103 respondents at a 5% significance level.

5.1 Exercise Equipment Usage

H_{01} (Null Hypothesis):

There is no significant evidence that more than 50% of respondents have used public park exercise equipment.

H_{11} (Alternative Hypothesis):

More than 50% of respondents have used public park exercise equipment.

In the survey, 82 of the 103 respondents had used public park exercise equipment, counting occasional users, regular users and those who had used it in the past. This amounts to 79.6% of respondents. A one-

proportion Z-test compared the observed share with the 50% reference value.

Statistical Test: One-Proportion Z-test

Result: Z = 6.01, p < 0.001

Decision: Supported. The results give significant evidence that more than 50% of respondents have used public park exercise equipment.

5.2 Interest in Electricity Generation

H_{02} (Null Hypothesis):

There is no significant evidence that more than 50% of respondents are interested in exercise equipment that generates electricity.

H_{12} (Alternative Hypothesis):

More than 50% of respondents are interested in exercise equipment that generates electricity.

In the survey, 68 of 103 respondents chose Very Interested, Interested or Slightly Interested regarding exercise equipment that generates electricity, which is 66.0%. A one-proportion Z-test checked whether this share was significantly above the 50% reference value.

Statistical Test: One-Proportion Z-test

Result: Z = 3.25, p = 0.0006

Decision: Supported. The results give significant evidence that more than 50% of respondents show some interest in electricity-generating exercise equipment.

5.3 Acceptance of RFID-Based Monitoring

H_{03} (Null Hypothesis):

There is no significant evidence that more than 50% of respondents accept RFID-based user identification and exercise equipment access.

H_{13} (Alternative Hypothesis):

More than 50% of respondents accept RFID-based user identification and exercise equipment access.

The survey produced 85 positive responses out of 103 (Definitely Yes and Probably Yes), or 82.5%. A one-proportion Z-test examined whether acceptance was significantly above the 50% reference value.

Statistical Test: One-Proportion Z-test

Result: Z = 6.60, p < 0.001

Decision: Supported. The results give significant evidence that more than 50% of respondents are willing to use RFID-based access for the proposed Smart Park system.

5.4 Willingness to Use the Smart Park

H_{04} (Null Hypothesis):

There is no significant evidence that more than 50% of respondents are likely to use the proposed Smart Park system.

H_{14} (Alternative Hypothesis):

More than 50% of respondents are likely to use the proposed Smart Park system.

The survey recorded 43 positive responses (Likely and Very Likely) out of 103, or 41.7%. A one proportion Z-test compared this share with the 50% reference value.

Statistical Test: One-Proportion Z-test

Result: Z = −1.68, p = 0.953

Decision: Not Supported. The results do not give sufficient statistical evidence that more than 50% of respondents are likely to use the proposed Smart Park system.

5.5 Acceptance of AI-Based Personalized Exercise Recommendations

H_{05} (Null Hypothesis):

There is no significant evidence that more than 50% of respondents prefer personalized exercise recommendations as the most useful AI-based Smart Park feature.

H_{15} (Alternative Hypothesis):

More than 50% of respondents prefer personalized exercise recommendations as the most useful AI-based Smart Park feature Of the 103 respondents, 41 picked personalized exercise recommendations as their preferred AI-based feature, i.e., 39.8%. A one-proportion Z-test compared this share with the 50%

reference value.

Statistical Test: One-Proportion Z-test

Result: Z = −2.07, p = 0.981 (one-tailed)

Decision: Not Supported. The results do not give sufficient statistical evidence that more than 50% of respondents selected personalized exercise recommendations as their preferred AI-based feature.

5.6 Preferences for AI-Based Smart Park Features

H_{06} (Null Hypothesis):

There is no significant difference in respondents' preferences among the proposed AI-based Smart Park features.

H_{16} (Alternative Hypothesis):

There is a significant difference in respondents' preferences among the proposed AI-based Smart Park features.

The survey looked at preferences across five AI-based features: personalized exercise recommendations, exercise progress analysis, energy generation tracking, monthly fitness and energy reports, and equipment fault detection. A chi-square goodness-of-fit test checked whether preferences were spread equally over the five categories. The observed counts were 41, 27, 22, 9 and 4, respectively.

Statistical Test: Chi-Square Goodness-of-Fit Test

Result: $\chi^2 = 42.19$, df = 4, $p < 0.001$

Decision: Supported. The results show a statistically significant difference in preferences among the proposed AI-based features Personalized exercise recommendations drew the most responses.

5.7 Preferences for Smart Park Rewards and Benefits

H_{07}(Null Hypothesis):

There is no significant difference in respondents' preferences among the proposed Smart Park rewards and benefits.

H_{17} (Alternative Hypothesis):

There is a significant difference in respondents' preferences among the proposed Smart Park rewards and benefits.

The survey looked at five benefits: electricity bill credit, fitness and health rewards, reward points, recognition for contribution, and discounts or coupons. A chi-square goodness-of-fit test checked whether preferences were spread equally over the five categories. The observed counts were 37, 26, 21, 12 and 7, respectively.

Statistical Test: Chi-Square Goodness-of-Fit Test

Result: $\chi^2 = 27.05$, df = 4, $p < 0.001$

Decision: Supported. The results show a statistically significant difference in preferences among the proposed rewards and benefits. Electricity bill credit drew the most responses.

5.8 Relationship Between Exercise Duration and Electricity Generation

H_{08} (Null Hypothesis):

There is no significant relationship between exercise duration and the electrical energy generated during an exercise session.

H_{18} (Alternative Hypothesis):

There is a significant relationship between exercise duration and the electrical energy generated during an exercise session.

This relationship can be tested by comparing the session duration logged by the IoT system with the electrical energy measured for the same session. Pearson correlation can be used to establish the direction and strength of the relationship.

Statistical Test: Pearson Correlation Analysis

Result: Not yet calculated. The survey data alone do not contain paired measurements of exercise session duration and actual electrical energy generation.

Decision: Pending experimental data collection and analysis.

6. RESEARCH METHODOLOGY

The proposed research follows an experimental, prototype-based methodology to develop and evaluate

the Smart Park. The methodology combines outdoor exercise equipment, power-generation mechanisms, IoT sensors, RFID-based user identification, database storage and AI/ML-based analysis, and the collected data is used to assess exercise activity, electricity generation, equipment performance and user acceptance.

The overall flow of the methodology appears in Fig. 1.

6.1 System Design and Prototype Development

The first stage is designing the Smart Park system. Suitable outdoor exercise machines are selected and coupled with a generator, so that the mechanical energy from exercising is converted into electricity.

The prototype comprises the exercise equipment, an energy-generation mechanism, IoT sensors, an RFID reader, a processing unit, a database connection and a monitoring interface, and it is built to capture exercise and power-generation details for every session.

6.2 RFID-Based User Identification

An RFID-based identification mechanism is built into the system to recognize registered Smart Park users. Each registered user is issued a unique RFID-based Smart Park Identity Card.

Before beginning a session, the user taps the card on the RFID reader. The system recognizes the user and links the session to the chosen equipment, the date, the time and other captured parameters.

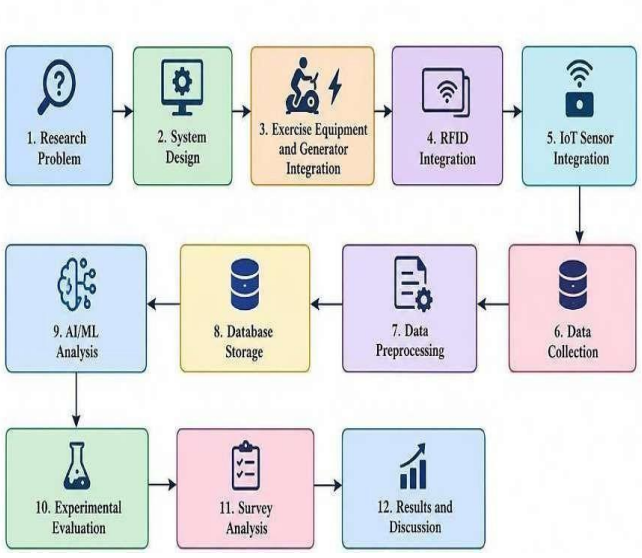


Fig. 1. Proposed methodology for the AI and IoT Based Smart Park.

6.3 IoT Sensor Integration

IoT sensors gather the needed exercise and electrical parameters from the connected equipment. The system can monitor quantities such as session duration, voltage, current and generated electrical energy.

Sensor readings are sent to the processing unit and saved in the database, so the system keeps an ongoing record of exercise activity and electricity generation.

6.4 Data Collection

Data is gathered from the Smart Park prototype across different exercise sessions. For each session the system logs the RFID-based user identification, the equipment used, the session duration, voltage, current and the measured electricity generated.

These records form the basis for studying the relationship between exercise activity and electricity generation, and the same data feeds the AI/ML analysis of exercise patterns and equipment performance.

6.5 Data Preprocessing

Before statistical and AI/ML analysis, the collected data is checked and prepared. Missing values, duplicate records and inconsistent sensor readings are identified and treated where needed.

The cleaned dataset is organized by attributes such as user ID, equipment ID, exercise duration, voltage, current and generated energy, and is then used for further analysis and model development.

6.6 Electricity Generation Measurement

The electrical power produced by the exercise equipment is computed from the measured voltage and current:

$$P = V \times I \qquad (1)$$

(Source: OpenStax, University Physics Volume 2, Section 9.5, “Electrical Energy and Power” [1].)

where P is electrical power in watts, V is voltage in volts and I is current in amperes.

The electrical energy generated can be calculated as:

$$E = P \times t \qquad (2)$$

(Source: OpenStax, University Physics Volume 2, Section 9.5, “Electrical Energy and Power” [1].)

For energy expressed in kilowatt-hours:

$$E(kWh) = (V \times I \times t) / 3{,}600{,}000 \quad (3)$$

(Source: NCERT, Class 10 Science, Chapter 11, "Electricity," Section 11.8, "Electric Power" [2].)

where t is the exercise duration in seconds. The measured energy is linked to the corresponding RFID-identified user and exercise session.

6.7 Database Storage and Monitoring

The gathered information is kept in a central database that holds per-user exercise and energy-generation records. Each record can include the user ID, the equipment used, date and time, session duration, electrical parameters and verified energy generated.

A monitoring dashboard can present details such as exercise activity, equipment usage and electricity generation, and gives a convenient interface for overseeing how the Smart Park operates.

6.8 AI and Machine Learning Analysis

AI and machine learning methods are applied to the collected Smart Park dataset to find useful patterns in exercise and energy-generation information. The analysis can concentrate on how exercise duration, equipment usage and electricity generation relate to one another.

The AI component can also be explored for detecting abnormal equipment behavior and studying equipment-performance patterns. Depending on the dataset and the chosen model, suitable performance measures can be used to assess the AI/ML results.

6.9 Experimental Setup

The prototype is tested under varied exercise conditions and durations in order to collect multiple observations. Different sessions are carried out on the connected equipment, and the matching electrical measurements are recorded. For every session, the RFID identification, equipment usage, session duration and electricity generated are logged. The observations are then compared to assess the relationship between exercise activity and electricity generation.

6.10 Circuit Design and Working Process of the Smart Park System

The Smart Park system is made up of exercise equipment coupled to an electricity-generating mechanism, voltage and current sensors, a microcontroller, an RFID reader and an IoT communication module. When a registered user scans an RFID card, the system recognizes the user and begins logging the session. As the user works the equipment, a generator converts mechanical energy into electrical energy. The voltage and current sensors measure the electrical output, and the microcontroller computes the generated power and energy. Details including user ID, equipment ID, session duration and generated electricity are sent to a database over an IoT connection. AI and machine learning can then be applied to study energy-generation patterns, track equipment performance and spot unusual sensor readings. The system is evaluated through several test cases that check RFID identification, sensor readings, energy calculations, data transmission and database storage.

6.10.1 System Testing and Test Cases

The system is assessed using test cases that verify that each major component works correctly. Every test case states the operation to be performed, the expected result and the observed result. The tests cover RFID user identification, voltage and current measurement, electricity-generation calculation, IoT data transmission and database storage, and they help reveal errors and show whether the system meets the intended requirements.

TABLE I
TEST CASES FOR THE PROPOSED SMART PARK SYSTEM

Test Case ID	Test Scenario	Expected Result
TC-01	RFID Identification	User identified successfully.
TC-02	Sensor Measurement	Voltage and current measured correctly.
TC-03	Energy Calculation	Power and energy calculated correctly.
TC-04	IoT Transmission	Data sent successfully to the cloud.
TC-05	Database Storage	Data stored correctly.
TC-06	AI/ML Analysis	Patterns and unusual readings identified.
TC-07	System Reliability	System operates consistently without major errors.

6.11 Evaluation Metrics

The system is evaluated using measurable technical and research parameters. The main ones are:

1. Exercise Duration: total time of one exercise session.
2. Voltage Generated: electrical voltage the equipment produces while operating.
3. Current Generated: electrical current produced during the session.
4. Electrical Energy Generated: total measurable electrical energy generated in one session.
5. Energy Generation Rate: electrical energy generated per unit of exercise time. Energy Generation Rate = Total Energy Generated / Exercise Duration
6. AI/ML Performance: the chosen AI/ML model can be assessed using measures such as accuracy, precision, recall, F1-score or regression error, depending on the model type.
7. User Acceptance: survey responses are analyzed to gauge acceptance of the Smart Park, RFID identification, exercise monitoring and electricity-generation features.

Together, the methodology provides a structured framework for developing and evaluating the Smart Park. It combines prototype development, IoT-based data collection, RFID-based user identification, electricity-generation measurement, AI/ML analysis and survey-based evaluation to study the technical feasibility and user acceptance of the system.

7. DATA ANALYSIS

A structured Google Form was used to collect survey data on the acceptance, interest and expectations of potential users toward the proposed Smart Park. A total of 103 responses were received and analyzed. The analysis covers respondent characteristics, public park usage, exercise equipment usage, interest in electricity generation, acceptance of RFID-based monitoring, AI/IoT features, data privacy, and possible rewards or electricity-related benefits.

7.1 Respondent Profile

Respondents came from varied age groups and occupations. Most were aged 18–25, accounting for 61 respondents (59.2%). By occupation, 51 respondents (49.5%) were students, followed by 25 working professionals (24.3%).

TABLE II RESPONDENT PROFILE

Category	Response	Number	Percentage
Age Group	Below 18	1	1.0%
Age Group	18–25	61	59.2%
Age Group	26–35	9	8.7%
Age Group	36–45	17	16.5%
Age Group	46–55	15	14.6%
Occupation	Student	51	49.5%
Occupation	Working Professional	25	24.3%
Occupation	Homemaker	12	11.7%
Occupation	Business/Self-employed	11	10.7%
Occupation	Other	4	3.9%

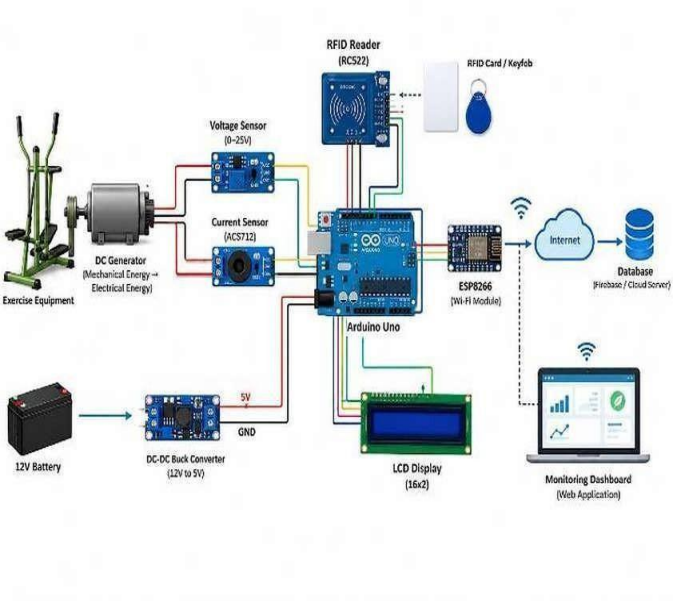


Fig. 2. Circuit Diagram of the Proposed AI and IoT-Based Smart Park System

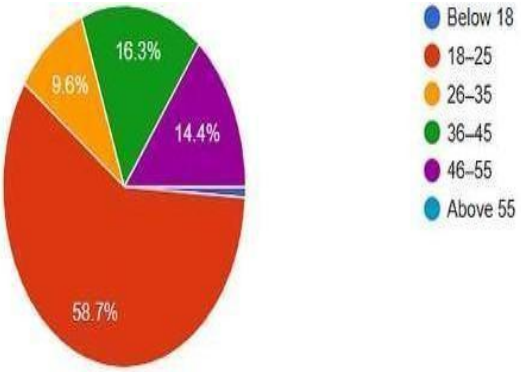


Fig. 3. Age group distribution of survey respondents.

Young people and students made up the largest groups in the respondent profile, but working professionals and other occupational groups also responded, which broadens the range of opinions.

7.2 Public Park Usage

The survey asked how often respondents visit public parks or gardens. The biggest group, 28 respondents (27.2%), visits 2–3 times a week, and 73 respondents (70.9%) visit at least once a week.

TABLE III PUBLIC PARK VISIT FREQUENCY

Park Visit Frequency	Number	Percentage
Daily	9	8.7%
4–6 times a week	19	18.4%
2–3 times a week	28	27.2%
Once a week	17	16.5%
Occasionally	18	17.5%
Rarely	12	11.7%

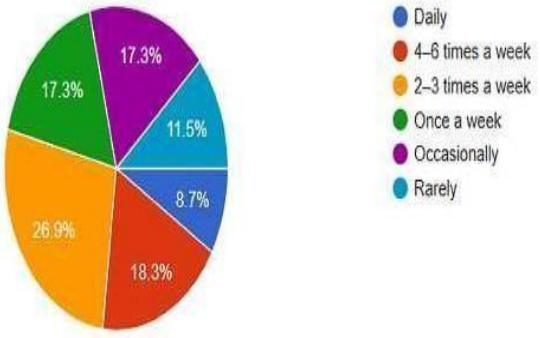


Fig. 4. Frequency of respondents' visits to public parks.

The results show that many respondents visit public parks on a regular basis, giving a suitable user environment in which to study the Smart Park concept.

7.3 Exercise Equipment Usage

The survey looked at the use of exercise equipment in public parks. Forty-three respondents (41.7%) said they use it occasionally and 16 (15.5%) use it regularly. In all, 93 respondents (90.3%) had either used the equipment or were interested in using it.

TABLE IV PUBLIC PARK EXERCISE EQUIPMENT USAGE

Response	Number	Percentage
Yes, occasionally	43	41.7%
I have used it before	23	22.3%
Yes, regularly	16	15.5%
No, but I am interested	11	10.7%
No, I am not interested	10	9.7%

The results reveal considerable familiarity with, or interest in, outdoor exercise equipment, which supports studying how exercise monitoring and electricity generation could be built into public park infrastructure.

7.4 Exercise Duration, Reasons, and Usage Barriers

The survey also covered exercise duration, reasons for exercising in parks, and factors that prevent regular use of the equipment. The most common duration was 20–30 minutes, reported by 33 respondents (32.0%). Mental relaxation was the reason chosen most often, by 27 respondents (26.5%), and lack of time was the most frequent barrier, cited by 23 respondents (22.5%).

TABLE V EXERCISE DURATION IN PUBLIC PARKS

Exercise Duration	Number	Percentage
Less than 10 minutes	9	8.7%
10–20 minutes	15	14.6%
20–30 minutes	33	32.0%
30–45 minutes	27	26.2%
More than 45 minutes	6	5.8%
Do not exercise in parks	13	12.6%

TABLE VI MAIN REASONS FOR EXERCISING IN PARKS

Reason	Number	Percentage
Mental relaxation	27	26.5%
Fitness and health	23	22.5%
Outdoor activity	19	18.6%
Weight management	14	13.7%
Free access to equipment	8	7.8%
Other	8	7.8%
Social activity	3	2.9%

The results suggest that exercise duration, availability and upkeep of equipment, and time constraints are all relevant to the proposed system. Dependable

equipment and easy activity monitoring may help ease some of these concerns.

7.5 Awareness and Interest in Electricity Generation

The survey asked about awareness of exercise equipment that produces electricity from human movement. Fifty-three respondents (51.5%) already knew of the concept, while 36 (35.0%) had heard of it but knew little.

On interest in using electricity-generating equipment, 68 respondents (66.0%) chose interested, very interested or slightly interested.

TABLE VII AWARENESS OF ELECTRICITY-GENERATING EXERCISE EQUIPMENT

Response	Number	Percentage
Yes	53	51.5%
Heard about it but do not know much	36	35.0%
No	14	13.6%

TABLE VIII INTEREST IN ELECTRICITY-GENERATING EXERCISE EQUIPMENT

Response	Number	Percentage
Very Interested	9	8.7%
Interested	27	26.2%
Slightly Interested	32	31.1%
Neutral	21	20.4%
Not Interested	14	13.6%

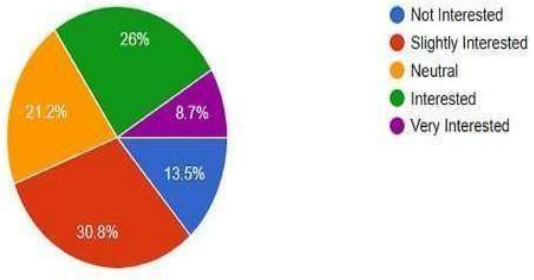


Fig. 5. Respondents' interest in electricity-generating exercise equipment.

The findings show that many respondents have at least some interest in combining exercise with electricity generation, which supports further study of the feasibility and user acceptance of the concept.

7.6 Importance of Renewable Energy in Public Places

Respondents were asked how important it is to use renewable or human-generated energy in public places. Among the 101 valid responses, 67 respondents (66.3%) selected interested, very interested or slightly interested.

TABLE IX INTEREST IN RENEWABLE OR HUMAN-GENERATED ENERGY

Response	Number	Percentage
Very Interested	11	10.9%
Interested	29	28.7%
Slightly Interested	27	26.7%
Neutral	19	18.8%
Not Interested	15	14.9%

The results indicate positive interest in human-generated energy in public places. This supports looking at exercise equipment as a supplementary electricity source, although the actual generation would depend on equipment design and measured output.

7.7 Acceptance of RFID-Based Monitoring

The survey asked whether respondents would use an RFID-based Smart Park card to access exercise equipment and log sessions. Sixty respondents (58.3%) chose Probably Yes and 25 (24.3%) chose Definitely Yes, so 85 respondents (82.5%) were positive overall about using an RFID-based card.

TABLE X ACCEPTANCE OF RFID-BASED SMART CARD

Response	Number	Percentage
Definitely Yes	25	24.3%
Probably Yes	60	58.3%
Not Sure	11	10.7%
Probably No	3	2.9%
Definitely No	4	3.9%

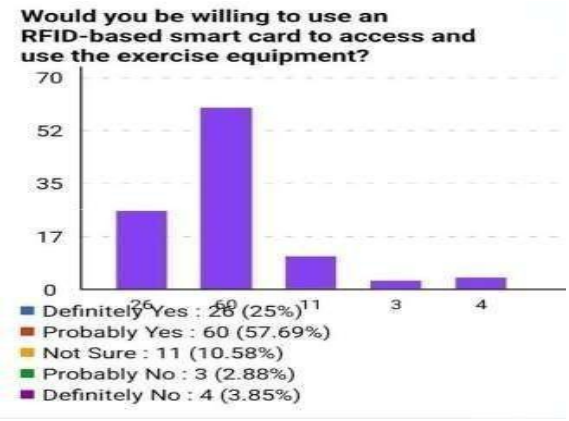


Fig. 6. Acceptance of RFID-based Smart Park identification.

The results show that most respondents are willing to use RFID-based identification, supporting the proposed use of RFID to link users with exercise sessions, equipment usage and the matching energy-generation records.

7.8 Exercise Monitoring and Recorded Information

The survey asked whether tracking exercise activity and progress could encourage more regular exercise. Eighty respondents (77.7%) chose Probably Yes or Definitely Yes. Respondents were also asked what information they would be comfortable having the Smart Park record, and equipment used was the most common choice, with 28 responses (27.2%).

TABLE XI ACCEPTANCE OF EXERCISE ACTIVITY TRACKING

Response	Number	Percentage
Definitely Yes	36	35.0%
Probably Yes	44	42.7%
Not Sure	8	7.8%
Probably No	8	7.8%
Definitely No	7	6.8%

TABLE XII INFORMATION USERS ARE COMFORTABLE RECORDING

Information	Number	Percentage
Equipment used	28	27.2%
Electricity generated	26	25.2%
Exercise duration	25	24.3%
Number of visits	12	11.7%
Exercise history	12	11.7%

The results suggest that exercise tracking may encourage regular activity for many respondents, who also showed interest in having equipment usage, generated electricity and exercise duration recorded. The system should state clearly what information it collects and how user data is protected.

7.9 Motivation Through Electricity Generation

The survey asked whether generating electricity while exercising would motivate respondents to visit a park more often. Fifty-one respondents (49.5%) chose Probably Yes and 20 (19.4%) chose Definitely Yes, giving 71 respondents (68.9%) with positive motivation.

TABLE XIII MOTIVATION TO VISIT PARKS THROUGH ELECTRICITY GENERATION

Response	Number	Percentage
Definitely Yes	20	19.4%
Probably Yes	51	49.5%
Not Sure	17	16.5%
Probably No	8	7.8%
Definitely No	7	6.8%

The findings suggest that electricity generation could add motivation to use parks. The real effect on visit frequency, however, would need to be assessed through implementation and further observation.

7.10 Preferred AI-Based Features and Data Comfort

The survey identified which AI-based features respondents found most useful. Personalized exercise recommendations were the top choice, picked by 41 respondents (39.8%), followed by exercise progress analysis, picked by 27 (26.2%).

TABLE XIV PREFERRED AI-BASED FEATUTABLE XIV PREFERRED AI-BASED FEATURERE

AI-Based Feature	Number	Percentage
Personalized exercise recommendations	41	39.8%
Exercise progress analysis	27	26.2%
Energy generation tracking	22	21.4%
Monthly fitness and energy report	9	8.7%
Equipment fault detection	4	3.9%

Of the 101 valid responses on AI data analysis, 48 respondents (47.5%) said they were comfortable or very comfortable with AI analyzing their exercise and energy-generation data.

TABLE XV COMFORT WITH AI ANALYSIS OF USER DATA

Response	Number	Percentage
Very Comfortable	11	10.9%
Comfortable	37	36.6%
Neutral	21	20.8%
Uncomfortable	15	14.9%
Very Uncomfortable	17	16.8%

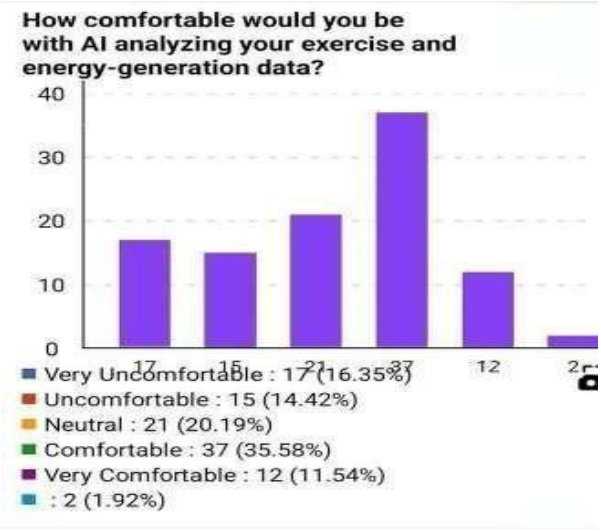


Fig. 7. Preferred AI-based features for the proposed Smart Park.

The results show interest in personalized recommendations, exercise progress analysis and energy tracking. Comfort with AI analysis is mixed, however, which underlines the need for transparency, consent and proper protection of personal data.

7.11 Interest in Rewards and Electricity-Bill Benefits

The survey examined which benefits would motivate respondents to use the Smart Park. Electricity-bill credit was favored most, chosen by 37 respondents (35.9%). Fitness and health rewards came next with 26 respondents (25.2%), followed by reward points with 21 (20.4%).

TABLE XVI BENEFITS THAT MAY MOTIVATE SMART PARK USAGE

Benefit	Number	Percentage
Electricity bill credit	37	35.9%
Fitness/Health rewards	26	25.2%
Reward points	21	20.4%
Recognition for contribution	12	11.7%
Discounts/Coupons	7	6.8%

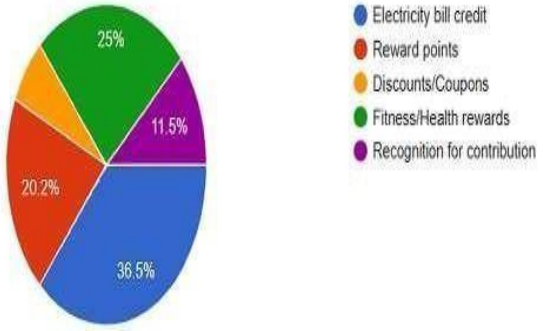


Fig. 8. Preferred benefits for using the proposed Smart Park.

The results show that electricity-bill credit is the incentive preferred most among the options listed, with fitness-related rewards and reward points also important to respondents. Any actual electricity-bill benefit, however, would depend on suitable government, electricity-provider, financial and regulatory policies.

7.12 Acceptance of the Proposed AI and IoT-Based Smart Park

The survey assessed how likely respondents are to use a Smart Park that combines exercise monitoring and electricity generation. Forty-three respondents (41.7%) chose Likely or Very Likely, while 27 (26.2%) were neutral.

TABLE XVII LIKELIHOOD OF USING THE PROPOSED SMART PARK

Response	Number	Percentage
Very Likely	13	12.6%
Likely	30	29.1%
Neutral	27	26.2%
Unlikely	10	9.7%
Very Unlikely	23	22.3%

Respondents were also asked whether Smart Parks could promote fitness and renewable energy in cities; 72 respondents (69.9%) chose Agree or Strongly Agree.

TABLE XVIII PERCEIVED CONTRIBUTION OF SMART PARKS

Response	Number	Percentage
Strongly Agree	33	32.0%
Agree	39	37.9%
Neutral	20	19.4%
Disagree	3	2.9%
Strongly Disagree	8	7.8%

The findings show favorable views on the potential contribution of Smart Parks to fitness and renewable energy. Likelihood of actual use is mixed, though, with 41.7% showing positive intent and 31.1% negative intent, which suggests that practical demonstrations, reliable equipment, clear data policies and suitable incentives could matter for wider acceptance.

Overall, the survey offers useful insight into user preferences and potential acceptance of the proposed Smart Park. The results reflect the views of 103 respondents and should not be taken as proof of actual electricity-generation performance or real-world effectiveness; those aspects require prototype testing and further evaluation.

8. RESEARCH FINDINGS

8.1 Positive Interest in the Smart Park Concept

In the survey, 66.0% of respondents expressed some interest in using exercise equipment that generates electricity, suggesting that pairing physical exercise with electricity generation could make public park activities more meaningful and engaging.

8.2 Good Acceptance of RFID-Based Monitoring

Of the respondents, 82.5% were positively willing to use an RFID-based Smart Park card, indicating that most support RFID identification for recording exercise sessions, equipment usage and electricity generation.

8.3 Interest in AI-Based Features

Personalized exercise recommendations were the most preferred AI-based feature (39.8% of respondents), followed by exercise progress analysis (26.2%) and energy-generation tracking (21.4%). Users thus appear interested in features that give useful information about their exercise performance and energy contribution.

8.4 Incentives Can Encourage Participation

Electricity-bill credit was the benefit preferred most (35.9% of respondents), followed by fitness and health rewards (25.2%) and reward points (20.4%). This suggests that suitable incentives may encourage participation in the Smart Park, although electricity-bill benefits would need approval from the appropriate government, electricity provider and regulators.

8.5 Interest in Exercise Monitoring

In the survey, 77.7% of respondents felt that tracking exercise activity could encourage more regular exercise, which supports the proposed use of RFID and IoT to record exercise duration, equipment usage and related activity data.

8.6 Overall Research Finding

Taken together, the survey points to positive interest in combining exercise monitoring, electricity generation, RFID, IoT and AI-based features. Respondents were interested in RFID-based identification, exercise tracking, personalized recommendations and incentives, which suggests the Smart Park could support physical activity and make use of the energy generated during exercise. Actual system performance, electricity generation and long-term user participation, however, would have to be assessed through prototype implementation and further testing.

9. RECOMMENDATIONS

9.1 Improve Smart Exercise Infrastructure

Public parks should progressively adopt exercise equipment fitted with suitable energy-generation mechanisms. The equipment should be safe, simple to use and well maintained so that users get a dependable experience.

9.2 Implement RFID-Based User Monitoring

Registered users can be given an RFID-based Smart Park card for easy identification, which helps log exercise duration, equipment usage and verified electricity generation and keeps user records organized.

9.3 Use AI for Useful Data Analysis

AI and machine learning should be used to analyze exercise and energy-generation data. The system can offer personalized recommendations, reveal activity patterns and help detect unusual equipment behavior.

9.4 Introduce Suitable User Incentives

The Smart Park can offer reward points, fitness-related benefits or other suitable incentives to encourage regular participation. Electricity-bill benefits can be explored later, once the required government and electricity-provider approvals are obtained.

9.5 Focus on Privacy, Safety and Maintenance

Information gathered through RFID and IoT devices should be stored securely and used only for appropriate purposes. Exercise equipment, sensors and electrical components should also be inspected and maintained regularly so that they operate safely and reliably.

10. CONCLUSION

The proposed AI and IoT Based Smart Park for Exercise Monitoring and Electricity Generation Using RFID offers a practical way to bring together physical exercise, electricity generation and smart technologies in public parks. Its central idea is to capture the mechanical energy people produce while exercising and convert it into usable electricity through suitable generating mechanisms attached to outdoor exercise equipment. IoT sensors can track key parameters such as session duration, voltage, current and the electricity produced in each session, and this information can be kept in a central database for monitoring and further analysis.

RFID offers a straightforward way to identify registered users and link their sessions to the equipment they use, which helps maintain per-user records of exercise activity, equipment usage and verified electricity generation. The AI and machine learning component can analyze the collected data to find exercise patterns, energy-generation patterns and equipment performance, help identify unusual equipment behavior and provide useful personalized exercise recommendations. IoT thus handles data collection and monitoring, while AI supplies meaningful analysis of the data.

The survey results are encouraging about acceptance of the Smart Park concept. A good number of respondents were interested in electricity-generating exercise equipment and RFID-based monitoring, and also in features such as energy-generation tracking and personalized exercise recommendations. Fitness and health rewards, reward points and possible electricity-bill benefits were among the incentives favored. These findings suggest that pairing exercise with smart monitoring and suitable incentives may draw more people to public park exercise activities.

Overall, the Smart Park can offer benefits in three areas: encouraging physical activity, putting the mechanical energy from exercise to use, and producing data for intelligent analysis. The proposed electricity-bill benefit, however, should be seen as a future possibility that would need government, electricity-provider, financial and regulatory approval, and the technical performance of the system still has to be verified through prototype development and experimental testing. Future work can concentrate on building a working prototype, measuring actual electricity generation under varied exercise conditions, refining the AI/ML analysis, securing data, and keeping equipment safe and reliable. With further development, testing and supportive policies, the system could help create more sustainable, interactive and intelligent public exercise facilities.

11. LIMITATIONS

1. Variable Electricity Generation: The electricity produced depends on the type of equipment, the duration of exercise and how intensely the user exercises.
2. Initial Cost and Maintenance: Generators, IoT sensors, RFID readers and other hardware can raise installation costs, and outdoor equipment and electrical components need regular maintenance.

12. FUTURE SCOPE OF RESEARCH

Going forward, a working prototype of the Smart Park can be built and tested in real park conditions. Different exercise equipment and generator technologies can be compared to improve electricity generation. AI and machine learning models can be refined using larger datasets to give personalized exercise recommendations, detect unusual equipment behavior and analyze energy-generation patterns. A mobile or web dashboard can be developed to show exercise activity and verified energy contributions, and the RFID system can be strengthened to keep secure user profiles and exercise records.

Later studies can also look at reward points, fitness benefits and other incentives tied to verified energy generation, with electricity-bill benefits considered once the necessary approvals are in place. Further work can address equipment safety, durability, sensor accuracy and maintenance. Larger surveys covering different age groups and locations can help assess user acceptance. Altogether, such development can make the Smart Park system more practical, efficient and sustainable.

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