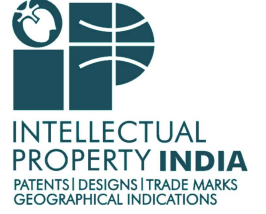


Welcome VIJAYARANGAN KAMATCHI KANNAN [Sign out](#)Controller General of Patents, Designs & Trade
Marks

सत्यमेव जयते

G.A.R.6
[See Rule 22(1)]
RECEIPT

Docket No 21771

Date/Time 2022/03/10 17:14:12

To
VIJAYARANGAN KAMATCHI KANNAN

UserId: KAMATCHI

52-4 / 1 KR Apartments, Kongu Nagar
Sathyamangalam

CBR Detail:

Sr. No.	Ref. No./Application No.	App. Number	Amount Paid	C.B.R. No.	Form Name	Remarks
1	202241013066	TEMP/E-1/15052/2022-CHE	1600	9544	FORM 1	Artificial Intelligence Method to Repurpose the EV Batteries for Secondary Applications

TransactionID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0000934267	Online Bank Transfer	1003220018714	1600.00	1475001020000001

Total Amount : ₹ 1600

Amount in Words: Rupees One Thousand Six Hundred Only

Received from VIJAYARANGAN KAMATCHI KANNAN the sum of ₹ 1600 on account of Payment of fee for above mentioned Application/Forms.

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<p>FORM 1 THE PATENTS ACT, 1970 (39 of 1970) & THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT [See sections 7,54 & 135 and rule 20(1)]</p>	<p>(FOR OFFICE USE ONLY)</p> <p>Application No.:</p> <p>Filing Date:</p> <p>Amount of Fee Paid:</p> <p>CBR No.:</p> <p>Signature:</p>
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1. APPLICANT(S):

Sr.No.	Name	Nationality	Address	Country	State
1	VIJAYARANGAN KAMATCHI KANNAN	India	52-4 / 1 KR Apartments, Kongu Nagar Sathyamangalam	India	Tamil Nadu
2	AMEER KHAN B	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
3	BUVANESHWARAN G	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
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5	KALAISELVAN R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
6	ARUNRAJA A S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
7	GOKUL R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology,	India	Tamil Nadu

			Sathyamangalam, Erode – 638401		
8	SHANKAR N	India	Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu

2. INVENTOR(S):

Sr.No.	Name	Nationality	Address	Country	State
1	VIJAYARANGAN KAMATCHI KANNAN	India	52-4 / 1 KR Apartments, Kongu Nagar Sathyamangalam	India	Tamil Nadu
2	AMEER KHAN B	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
3	BUVANESHWARAN G	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
4	CHANDRU M	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
5	KALAISELVAN R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
6	ARUNRAJA A S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu
7	GOKUL R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu

8	SHANKAR N	India	Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu
---	-----------	-------	---	-------	---------------

3. TITLE OF THE INVENTION: Artificial Intelligence Method to Repurpose the EV Batteries for Secondary Applications

4. ADDRESS FOR CORRESPONDENCE OF APPLICANT / AUTHORISED PATENT AGENT IN INDIA:

Associate Professor, Department of EEE,
Bannari Amman Institute of Technology,
Sathyamangalam, Erode – 638401.

Telephone No.:

Fax No.:

Mobile No: 9944374946

E-

mail: kannan.ped@gmail.com

5. PRIORITY PARTICULARS OF THE APPLICATION(S) FILED IN CONVENTION COUNTRY:

Sr.No.	Country	Application Number	Filing Date	Name of the Applicant	Title of the Invention
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6. PARTICULARS FOR FILING PATENT COOPERATION TREATY (PCT) NATIONAL PHASE APPLICATION:

International Application Number	International Filing Date as Allotted by the Receiving Office
PCT//	

7. PARTICULARS FOR FILING DIVISIONAL APPLICATION

Original (first) Application Number	Date of Filing of Original (first) Application

8. PARTICULARS FOR FILING PATENT OF ADDITION:

Main Application / Patent Number:	Date of Filing of Main Application

9. DECLARATIONS:

(i) Declaration by the inventor(s)

I/We ,VIJAYARANGAN KAMATCHI KANNAN,AMEER KHAN B,BUVANESHWARAN G,CHANDRU M,KALAISELVAN R,ARUNRAJA A S,GOKUL R,SHANKAR N, is/are the true & first inventor(s) for this invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date: -----

(b) Signature(s) of the inventor(s):

(c) Name(s): VIJAYARANGAN KAMATCHI KANNAN,AMEER KHAN B,BUVANESHWARAN G,CHANDRU M,KALAISELVAN R,ARUNRAJA A S,GOKUL R,SHANKAR N

(ii) Declaration by the applicant(s) in the convention country

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date: -----

(b) Signature(s) :

(c) Name(s) of the singnatory: VIJAYARANGAN KAMATCHI KANNAN,AMEER KHAN B,BUVANESHWARAN G,CHANDRU M,KALAISELVAN R,ARUNRAJA A S,GOKUL R,SHANKAR N

(iii) Declaration by the applicant(s)

- **The Complete specification relating to the invention is filed with this application.**
- **I am/We are, in the possession of the above mentioned invention.**
- **There is no lawful ground of objection to the grant of the Patent to me/us.**
- **I am/We are, the assignee or legal representative to true first inventors.**

10. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION:

Sr.	Document Description	FileName
1	COMPLETE SPECIFICATION	complete specification.pdf
2	DRAWINGS	diagrams.pdf
3	STATEMENT OF UNDERTAKING (FORM 3)	form 3.pdf
4	DECLARATION OF INVENTORSHIP (FORM 5)	form 5.pdf

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters stated hereing are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this(Final Payment Date): -----

Signature:

Name: VIJAYARANGAN KAMATCHI KANNAN

To The Controller of Patents

The Patent office at CHENNAI

This form is electronically generated.

Print

Artificial Intelligence Method to Repurpose the EV Batteries for

Secondary Applications

COMPLETE SPECIFICATION

5 FIELD OF THE INVENTION

This invention mainly focuses on artificial intelligence method to re-purposing EV battery packs for secondary applications in order to significantly increase their overall lifespan based on state-of-charge database.

BACKGROUND OF INVENTION

10 Vehicle electrification is beneficial to society because it offers greater fuel mileage for hybrid vehicles, lower net greenhouse gas emissions, and lower fuel and operating costs. The long-term movement away from “mild” hybrids, where the electric motor gives a performance-assist to full hybrids, and electric vehicles (EVs), has led to developments in battery technologies, most of which use lithium-ion (Li-ion)
15 chemistries. Due to their higher energy density, Li-ion batteries are the industry standard for EVs. Although the use of electric vehicle (EV) vehicles with Li-ion batteries reduces greenhouse gases caused by the use of fossil fuels, there are some disadvantages to their use. The key concerns with using Li-ion batteries are an increase in cost, weight, size, and the greater material and financial investment that must be
20 made at the beginning of the battery’s useful life.

When Li-ion batteries from EVs reach their end-of-life (EOL), they can be recycled to recapture some of the materials. However, recycling batteries is not an economical proposition, as the materials being used to create EV batteries are decreasing in recyclable value, with the shift to LiFePO₄, and because EV batteries

typically retain 80% of their originally manufactured energy storage capacity when they are removed from functioning vehicles. The 80% capacity estimation is a rule-of-thumb approximation that is used to roughly determine the condition of a Li-ion EV battery when it is removed from a vehicle. This particular rule-of-thumb is commonly used in
5 research to help determine a benchmark for second-use battery performance. However, in practice, the repurposing of an EV battery would require the use of battery testing infrastructure that would be used to confirm the battery state-of-health (SOH) and energy storage capacity of the battery. This step would be essential as the SOH and remaining energy storage capacity of the battery would depend on the battery's first use
10 and capacity. As EV batteries typically leave vehicles with most of their energy and capacity intact, it is essential that new applications are developed to better utilize EV batteries during their use phase are developed. To extend the useful life of the EV battery, the pack can be re-purposed for a secondary use which delays the battery recycling. In this proposed system, the Li-ion battery is used in a various stationary
15 application such as storage for renewable energy integration, to charge other EVs or to provide backup power.

Our proposed re-purpose system consists of

1. Battery pack
2. Charger
- 20 3. Inverter
4. Control unit
5. Power supply unit

SUMMARY OF THE INVENTION

The use of energy storage devices, such as re-purposed battery packs, can be used to help manage the electric loads on the grid. The lifecycle of Li-ion batteries has been explored with a focus on comparing current practices for EV batteries at their EOL, to looking at the potential for second-use applications. By re-purposing EV batteries for stationary energy storage application, there is a significant potential greenhouse gas emissions reduction of 56%, or 24 tonnes of CO₂, over the total 18-year lifetime of the battery. Re-purposing EV battery packs for secondary applications can significantly increase their overall lifespan. When applied to a second use, there is a much more stable setting for the EV battery. During the automotive service life, the Li-ion batteries must meet rapidly fluctuating demands for acceleration and deceleration that are dependent on the vehicle's driver. In the second use, however, the fluctuation in energy demand and charge is smaller, which helps the battery to maintain its energy storage capacity longer. Additionally, when the batteries are used in stationary applications, the batteries can be stored in a way that optimizes climate control as there are less size and weight restrictions.

Despite the many benefits of re-purposing Li-ion batteries, there are factors that impede the widespread adoption of this concept. One impediment is that a design methodology and certifications to ensure product safety are not currently available for repurposed EV batteries. Herein, the proposed design is mainly for building a stationary energy storage system using re-purposed battery packs. Re-purposed EV battery packs can feed electricity into the grid or can store energy and therefore must meet the standards for energy storage.

DETAILED DESCRIPTION OF THE INVENTION

The bench test set-up of the proposed potential housing and energy storage system layout is shown in the figure 1. Within the set-up, the electrician would install the repurposed electric vehicle battery which previously operated at 230 V, a charger, an inverter, and AI based controller, as shown in Figure 1. EV batteries are made up of smaller battery modules. These modules can be split-off into 12 V sections that allow for greater flexibility when packaging the system. Additionally, this configuration reduces the overall operating voltage, making it safer to use. As most of the components in the solar industry run on this voltage, this makes the battery useful for offering energy storage from roof-mounted solar panels.

As shown in Figure 2, the use cases for battery pack involve charging and discharging the battery, as well as making general repairs and the initial installation. The components involved in achieving the goals of these use cases are detailed in the diagram including the events that must transpire to reach either of the goals. The proposed system in the re-purposed EV battery pack are divided into the components of the system: charger, inverter, battery pack, AI based controller, and battery pack casing. The system proved functional, being able to charge the constructed 28.8 V pack using the charger and the energy supplied from a 230 V receptacle. Once the pack was charged, the charger was manually disconnected, and the system was connected to the inverter and universal power supply to act as a load. When connected, the small pack was able to charge the universal power supply and deliver energy. This manual process was repeated to prove the ability of the setup to function correctly.

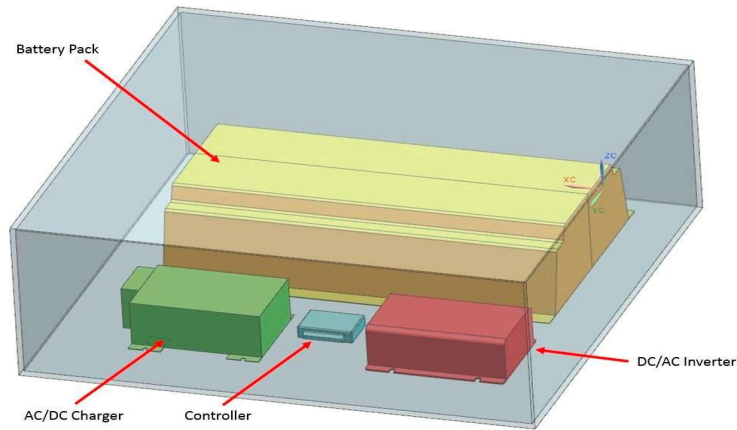


Figure 1: Bench test setup

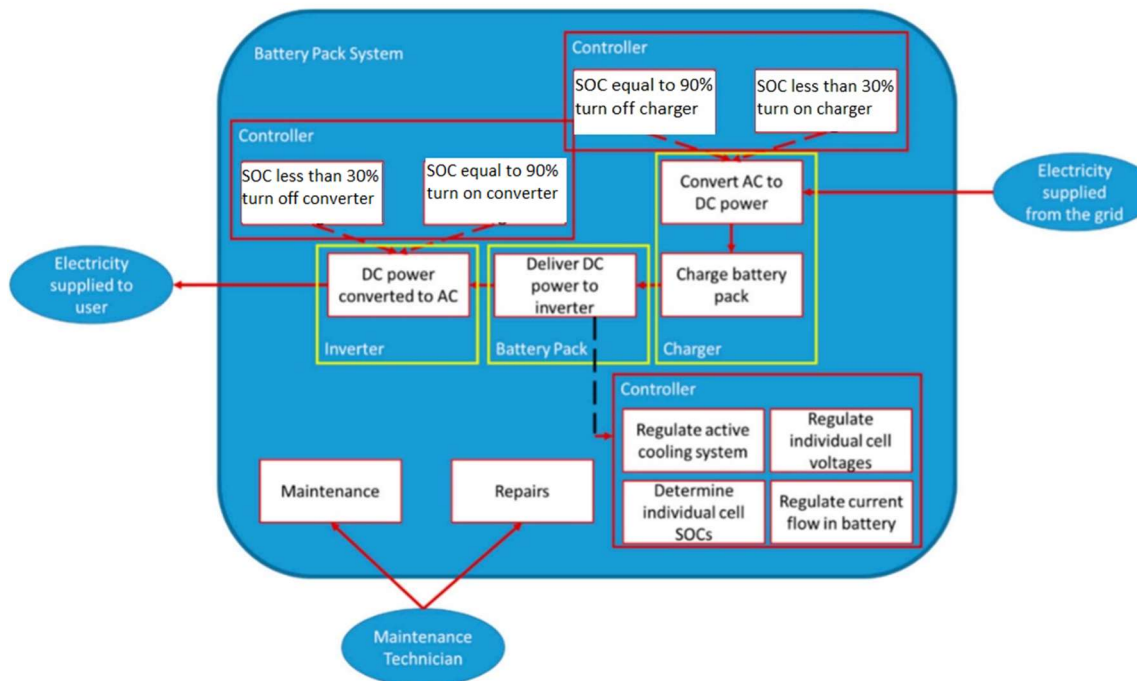


Figure 2: Block diagram of the proposed system

FORM 3

THE PATENTS ACT, 1970

(39 of 1970)

and

THE PATENTS RULES, 2003

STATEMENT AND UNDERTAKING UNDER SECTION 8

(See section 8; Rule 12)

1. Name of the applicant(s).						I/We AMEER KHAN B, BUVANESHWARAN G, CHANDRU M, KALAISELVAN R, ARUNRAJA A S, GOKUL R, KAMATCHI KANNAN VIJAYARANGAN, SHANKAR N hereby declare:					
2. Name, address and nationality of the joint applicant.						(i) that I/We have not made any application for the same/substantially the same invention outside India Or (ii) that I/We who have made this application No.....datedalone/jointly with, made for the same/substantially same invention, application(s) for patent in the other countries, the particulars of which are given below:					
Name of the country	Date of application	Applicati on No.	Status of the application	Date of publication	Date of grant						
3. Name and address of the assignee						(iii) that the rights in the application(s) has/have been assigned to KAMATCHI KANNAN VIJAYARANGAN					

	<p>ASP/EEE, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu 638 401</p> <p>that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application.</p> <p>Dated 10th day of March 2022</p>
<p>4. To be signed by the applicant or his authorized registered patent agent.</p>	<p>Signature.</p>
<p>5. Name of the natural person who has signed.</p>	<p>(Dr.V.Kamatchi Kannan).</p>
	<p>To</p> <p>The Controller of Patents,</p> <p>The Patent Office,</p> <p>at.....</p>
<p>Note.- Strike out whichever is not applicable;</p>	

FORM 5
THE PATENT ACT, 1970
(39 OF 1970)
&
The Patents Rules, 2003
DECLARATION AS TO INVENTORSHIP
[See section 10(6) and Rule 13(6)]

1. NAME OF APPLICANTS	AMEER KHAN B UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	BUVANESHWARAN G UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	CHANDRU M UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	KALAISELVAN R UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	ARUNRAJA A S UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	GOKUL R UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
	KAMATCHI KANNAN VIJAYARANGAN Associate Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.
	SHANKAR N Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.
hereby declare that the true and first inventor(s) of the invention disclosed in the complete specification filed in pursuance of our application numbered _____/CHE/2021 dated _____ are	
2. INVENTOR (S)	
1.	(a) Name AMEER KHAN B (b) Nationality India (c) Address UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
2.	(a) Name BUVANESHWARAN G (b) Nationality India (c) Address UG Student, Department of EEE, Bannari Amman Institute of

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3. (a) Name CHANDRU M
(b) Nationality India
(c) Address UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
4. (a) Name KALAISELVAN R
(b) Nationality India
(c) Address UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
5. (a) Name ARUNRAJA A S
(b) Nationality India
(c) Address UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
6. (a) Name GOKUL R
(b) Nationality India
(c) Address UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
7. (a) Name KAMATCHI KANNAN VIJAYARANGAN
(b) Nationality India
(c) Address Associate Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu 638 401
8. (a) Name SHANKAR N
(b) Nationality India
(c) Address Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu 638 401

Dated this 10th day of March 2022

Signature :

Name: Dr. V. Kamatchi Kannan

3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT (S) IN THE CONVENTION COUNTRY:-

-NA-

**To,
The Controller of Patent
The Patent Office, at Chennai.**

