Supplementary Material

AN Overview of Integration of Blockchain with Artificial Intelligence Technologies in The Energy Sector: A Systematic Review

A diagram of a diagram

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Figure 1. Types of blockchains

Table 1. ML learning techniques

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Supervised Learning** | **Un-Supervised Learning** | | | **Semi-Supervised Learning** | **Reinforcement Learning** |
| Used labelled data to train the machine. E.g., classification & regression | | Machine is pushed to train itself with unlabelled data.  E.g., clustering & association | Machine uses less labelled data and more unlabelled data to train. | | Interact with the environment to train.  E.g., robot & gaming |

A diagram of a neuron structure

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Figure 2. Biological neuron model

A diagram of a building

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Figure 3. Smart city

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Major applications of Blockchain in the energy domain** | | | | | |
| Energy management system | Energy trading (Peer-to-peer) | Smart grids | Electric vehicle | Energy storage | Carbon emission |

Table 2. The main applications of Blockchain in the energy sector

A diagram of a stage

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Figure 4. Systematic review stages

**Table 3.** Research inclusion and exclusion criteria

|  |  |  |
| --- | --- | --- |
| **Inclusion criteria** | | **Exclusion criteria** |
| Journal articles  Conference proceedings  Book chapters  Magazines | Prior to year 2018  Non-English language  Irrelevant to the scope of the article  Duplicate | |

**Table 4.** Initial results with first screening step

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Digital library** | **IEEE Xplore** | **Springer**  **Link** | | **ScienceDirect** | | **ACM** |
| Preliminary results  < 2018  Remainder  Total | 113,547  40,862  72,685 | | 16,916  64  16,852  **236,300** | 194,103  93,973  100,130 | 144,636  98,003  46,633 | |

**Table 5.** Second results with application of inclusion and exclusion criteria

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Digital library | IEEE Xplore | SpringerLink | | ScienceDirect | ACM |
| Secondary results  With exclusion & inclusion criteria  Remainder  Total | 72,685  72,301  384 | | 16,852  16,747  105  **1236** | 100,130  99,640  490 | 46,633  46,376  2547 |

**Table 6.** Final results with confirming study topic compliancy

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Digital library** | **IEEE Xplore** | **Springer**  **Link** | | **ScienceDirect** | | **ACM** | **Others**  **(i.e., MDPI)** | |
| Final screening results  Out of “Energy” scope  Remainder  Total | 384  364  21 | | 105  105  0  **27** | 490  486  4 | 257  257  0 | | | -  -  2 |

A diagram of a blockchain layer

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**Figure 5.** General AI-Blockchain energy architecture

Figure 6. AI-Blockchain integration advantages

A diagram of a blockchain

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