

Machine learning applications to smart city

Badri Narayan Mohapatra^{1*} and Prangya Prava Panda²

Assistant Professor, Department of Instrumentation & Control, AISSMS IOIT, Pune, India¹

B.Tech Student, Department of Computer Science, The Techno School, Bhubaneswar, India²

Received: 21-December-2018; Revised: 23-February-2019; Accepted: 25-February-2019

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Abstract

The basic need of human is increasing as they interact with different devices and also, they provide many feedbacks. Many smart devices generate high data and that can be retrieved and reviewed by humans. Applications are not fixed as it increases day to day life. Based on these data generated by different smart devices and smart city applications machine learning approach is the best adaptive solution. Rapid development in software, hardware with high speed internet connection provides large data to this physical world. The key contribution of this paper is a machine learning application survey towards smart city.

Keywords

Smart city, Machine learning, Machine learning algorithm, Smart city application.

1.Introduction

Driving style and driving condition have a big impact on vehicle fuel emission as well as consumption. Critical knowledge about road type and related to congested traffic will get help by implementing machine learning algorithm [1]. Machine learning will help the power for control of hybrid vehicle [2]. To reduce delays in traffic and to reduce emissions or we can say for optimization through the prediction through looking past and present scenario by observing the complete set of combination then machine learning will approach the best optional set for multiple traffic controller [3]. Machine learning like linear regression and neural network helps in estimation of energy which will be helpful in smart city [4].

Cities that are supported by an extensive digital infrastructure of sensors, databases and intelligent applications [5] accurate identification of criminal activity easily possible in smart cities using deep learning [6]. Machine learning also help by providing information to the flight management system also helps to pilot for taking some risk decision [7]. Modern life will change by using machine learning algorithm based on historical approach.

The way we interact with the world, there is beautiful machine learning technologies can have the prediction the data driven decision with ability to monitor and manage advanced devices smoothly.

2.Smart city

Smart refers to demand of more services to increase complexity with increase population. Smart means it should handle the problem intelligently with improved service like energy, public health, transportation, traffic management and many more. Smart city uses internet of things for fast communication and easy pass of information. Smart means to enhance starting from education, entertainment, business, city wastage, utilities all to increase the quality of living. It provides an integrated approach for successful critical planning goals. Now a day's machine learning has become remarkable and used in many applications like medical diagnosis and also used in computer vision. It is also a promising technique to enhance society and also useful to find or identify malicious in cyber world. *Figure 1* shows the applications of machine learning.

- Machine learning application is more towards smart city.
- Machine learning algorithm helps to smart city mission.

*Author for correspondence

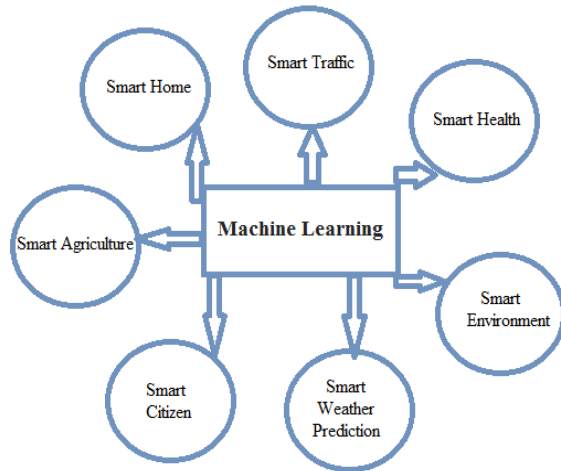


Figure 1 Applications of machine learning

3. Machine learning applications

Cell profile learning analyst function can easily do by machine and more suitable for image base measurement [8]. Patient based deep brain close loop simulator can be created using machine learning [9]. Personal sensing for translating row sensor and status related to human behaviour and mental health according to the use of computers, social media & smart phones, machine learning can know easily the status of the mental requirements [10]. Early detection also possible for sarcoma patients [11]. Analysis & study of diabetes through machine learning will be helpful to doctors easily [12]. Health based large electronic resends as well as large valuable information with machine learning give a very good remarkable to the health science by examining diabetes [13]. Machine learning, prediction about solar radiation and solar output power for grid operation in grid point management [14]. The machine learning approach will be very helpful for realization of comfort with the addition of energy saving [15]. Boosted regression tree, random forest tree and boosted tree is the machine learning approach which will produce the potential of most value able ground level fresh water [16].

Machine learning which could significantly improve the best monitoring the air quality by calibrating real time pollutant data sensor package [17].

Also, the air quality can be calculated by different concentration and percentage range [18]. To train an effective model, a huge amount of data from past decade entitled as AIRNet which will predict air quality by machine learning approach [19].

The approach of machine learning is to predict the generation of solar power from the past, whether the database [20]. The reflection of data from both researchers and practitioners has emerged important to business intelligence and all this kind of emerging research through machine learning effect the characteristic of the business analytics [21]. Transparent machine learning will require depth knowledge for empowering beyond human computation [22]. Identifying bubbles in a substrate and repeatable and qualify able from the dust through machine learning [23]. The complex relationship between surface, ground and climate water can easily implemented in machine learning algorithm which will help agriculture region [24].

Risk of figures and early detection of myrtle rust can be possible by machine learning [25]. Machine learning has a greater impact of nitrogen estimation, lead this large and makes a great attention in agriculture [26]. Machine learning makes high impact on production in agricultural [27]. Huge information from the different multispeed camera will predict to estimate corn crops [28]. Linear regression of machine learning help to agriculture [29].

Home automation by a speech and device reorganization and control by machine learning very helpful number of needs of the home [30, 31]. Wide verities operational data from home as well as live system are helpful for optimization and also in saving energy more [32]. Suicide and emotion concept identify through machine learning [33]. By use of large amounts of data set with the use of smart home sensors, machine learning predicts human activity [34, 35]. Machine learning approach predicts human activity by smartly considering human-computer interaction and pattern reorganization methods [36, 37]. *Figure 2* shows the applications based on smart city.

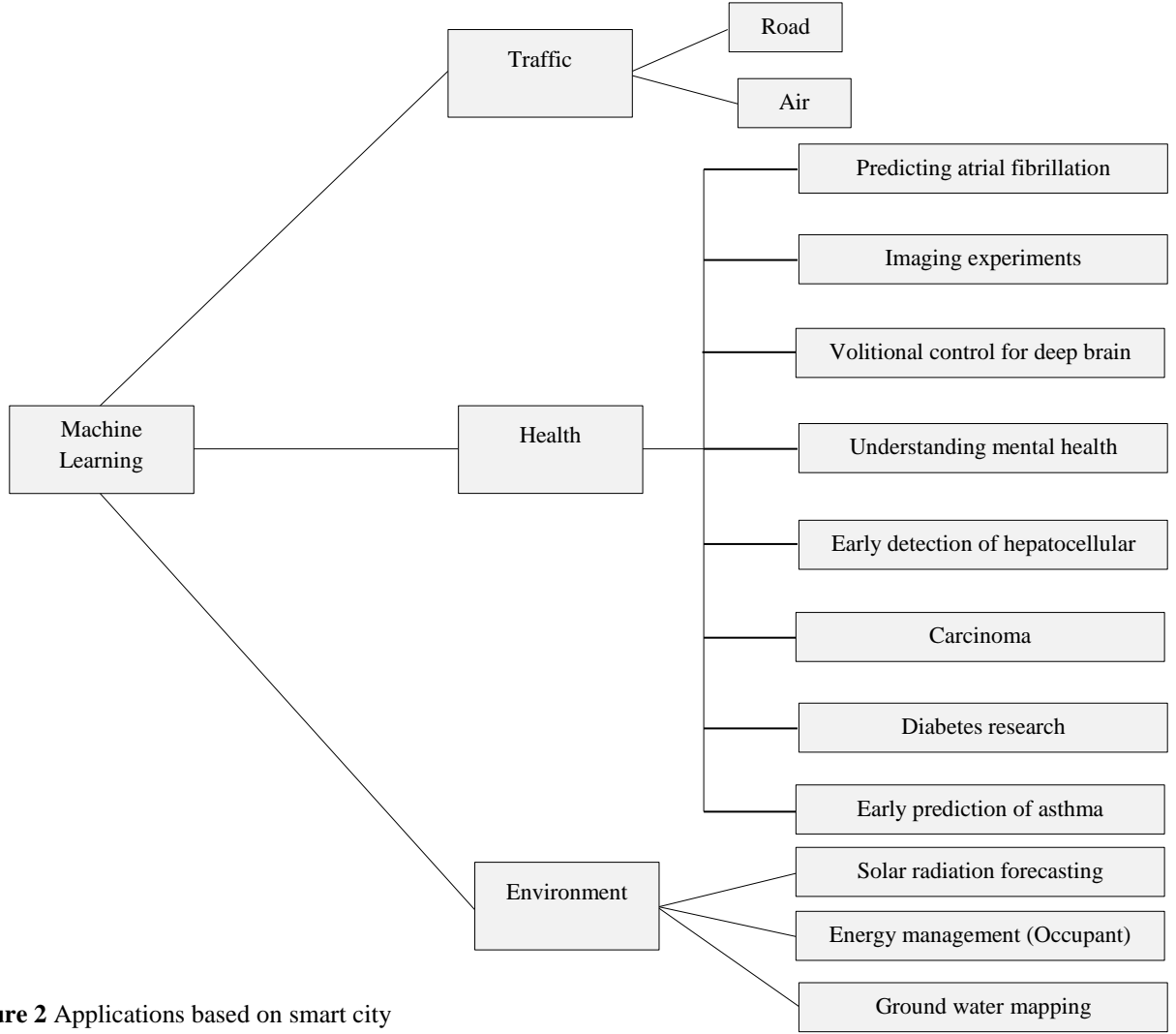


Figure 2 Applications based on smart city

4. Machine learning algorithm

K-means algorithm is the simplest partitioning method for clustering analysis and widely used in data mining applications.

$$E = \sum_{k=1}^K \sum_{\mathbf{x} \in C_k} d^2(\mathbf{x}, \mathbf{m}_k) \quad (1)$$

Optimal partition achieved via minimising the sum of squared distance to its “representative object” in each cluster for example Euclidean distance.

$$d^2(\mathbf{x}, \mathbf{m}_k) = \sum_{n=1}^N (x_n - m_{kn})^2 \quad (2)$$

The process of grouping a set of objects into classes of similar objects is known as clustering. Equation 1 and 2 used for k-means algorithm.

Machine learning investigates the mechanisms by which knowledge is acquired through experience.

There is different type of clustering methods like hierarchical, parametric and density based. K-means, mixture models comes under parametric clustering.

One class support vector machine (OCSVM) algorithm maps input data into a high dimensional feature space and iteratively finds the maximal margin in the hyper plane which best separates the training data from the origin. The machine learning algorithm can classify as unsupervised, supervised and reinforcement learning. Modifications and optimization of analytical data very easily through machine learning algorithm. Linear regression based on multiplied with some constant. Breaking into smallest data set with recursion until all data set used. LASSO regression means ‘Least absolute shrinkage and selection operators. Figure 3 shows the classification of supervised learning.

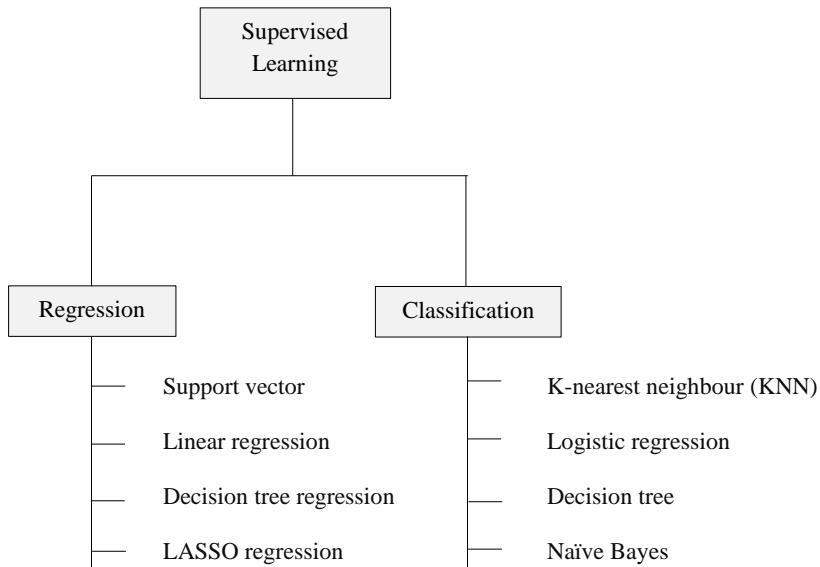


Figure 3 Classification of supervised learning

According to classification KNN is usually used for its simplicity. We can calculate the posterior probability, by Bayes theorem and easy to handle complex parameter estimation.

In case of unsupervised learning the algorithms organize data into a group of clusters to make a simple structure description. Reinforced learning is a

special application of machine learning to solve problems. In supervised learning, machine take set of examples where in unsupervised machine tries to find hidden unlabelled or unstructured data. Different type of useful algorithm used for different smart application shown in *Table 1*. For appropriate output one should use a machine learning algorithm to get desired results.

Table 1 Purpose of machine learning algorithm

Machine learning algorithms	Purpose
Feed forward neural network	Smart health
Densities based clustering and regression	Smart citizen
K-means	Smart city, Smart home
Clustering & anomaly detector	Smart traffic
One class support vector machine	Smart human active control
Support vector regression	Smart whether
Linear regression	Smart market analysis

Several data mining the intrusion detection can be easily possible by supervised, semi-supervised and unsupervised machine learning [38].

5. Conclusion

The machine learning algorithm provides services smart city. The services include energy motilities. Choosing suitable algorithm can give a good result for the important issue. Big data should be required for accuracy in machine learning algorithm. Machine learning has the challenges with variety, volume and velocity increasing with big data management. To reach good and suitable decision as there are different algorithms are there to use to get appropriate output.

In future more studies on many other open questions involving investigations algorithms based on smart city should be investigated with different collaborative approach. More development and more implementation can be possible due to the machine learning algorithm and machine learning algorithms have the potential to make it successful.

Acknowledgment

None.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Badri Narayan Mohapatra started his research on communication at the Centurion University of Technology and Management, Odisha. He did his B.E. from Berhampur University, Odisha and M.Tech from Biju Patnaik University of Technology, Rourkela, Odisha. His research area covers Light Propagation, Digital Signal and Image Processing.
Email: badri1.mohapatra@gmail.com



Prangya Prava Panda did her Diploma from Government Polytechnic, Bhubaneswar, Odisha. Now she is continuing B.Tech in CSE Department in The Techno School, Bhubaneswar, Odisha.