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Evaluating Data Mining Classification Methods Performance in Internet of Things Applications

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Abstract: The world is passing through the stage of the superiority of science and technology. The impact of this superiority in human life cannot be hidden. There is no doubt that the societies that have acquired information and knowledge are the ones who rule the world and lead the scene in the developed and modern countries. The development of the advanced applications in the field of the Internet of Things (IoT) with the development of information and communication technologies make the IoT have the ability to link physical entities and support interaction with the human element. The data that are generated by IoT is a huge data that has a high commercial value, also the algorithms of data mining can be applied on the IoT to get the hidden data. In this paper, a systematic method is presented to review the extraction of defined data classification. The latest algorithms of classification must be analyzed to be applied on the big data. These algorithms had been reviewed and the challenges had been discussed also in terms of data accuracy to choose the most accurate algorithm. According to the reviewed papers in the fields of smart environment, healthcare and agriculture, the highest accuracy results were found.

Keywords: Internet of Things (IoT), machine learning, classification, IoT applications, smart city

1. Introduction

Nowadays, internet communication becomes a major part of the infrastructure. Based on the internet most of the applications of infrastructure systems can be operated [1]. The vital purpose of IoT is to construct an advanced community era which routinely seizes the necessities of customers and will function in an issue of view [2]. On the begin, in the year (1999), the era of the Massachusetts Institute (MIT) put advanced the perception of IoT [3]. The IoT is like statistics and topics around the 'clock' related via the net [4], [5]. The IoT moreover perspectives everything because the identical, as topics. these items consist of 'Smartphones', 'clients', 'processing-gadgets-tablets',

'Bluetooth', 'ZigBee', 'Infrared data association' (IrDA), 'cell networks', 'Data centers (DCs)', 'Ultra-Wideband (UWB)', 'Near Field Communication (NFC)', 'DCs', 'RFID', 'chips and sensors', motors, Wristwatches, family machine way "IoT" is aggregate of real topics and virtual topics which can be associated each time and anywhere[6]. its miles anticipated to the touch 50 billion with the aid of the forestall of 2020 [7]. The IoT and Big Data has been called the technological waves, and they have contributions to increasing and expanding information, taking into consideration the difficulties in achieving consensus in its content of opinions due to its contradictions and differences of views [7], [8]. As its content is from various disciplines, as well as the vast amount of information produced by individuals and their interactions, and the reflection of this on knowledge and its management and decision-making based on it in an environment that has become a lot based on smart business environments and depends on intelligence and technology [4], [9], [10].

The information generated" or collected" through those tools is huge in extent. "This information may be in giant quantities for a gadget, and massive for a bigger device [11]. To preserve and convey significant business employer information out of this information, to offer Wi-Fi offerings to development of the industrial agency boom and machine planning information mining is critical [12], [13], [14]. The principle assignment is to select a suitable set of regulations for a sure IoT device, as their numerous gadget and algorithms to be had in facts mining. the principal aim of any mining of data method is to installation a nicely prepared analytical or expressive instance of data that no longer nice satisfactory wireless suits or describes it, even though capable of generalizing to newly generated records. facts mining mainly wireless categorized into techniques [11], [15], [16]. The description of "mining of data" and the opposite is predictive facts mining [2], [17]. [18]. In description "mining of data" information is analyzed in a quick and gathered manner and offers giant widespread homes of the statistics [19], [20].

In predictive statistics data analysis in a chain to assemble a single or Wi-Fi of information models and endeavours to are watching for the performance of the newly produced facts sets through the usage of techniques like regression, elegance and style assessment. records mining may be considered as a critical method in the statistics removing in these series noise and inconsistent statistics is eliminated. facts integration - This step combines more than one fact resources [21].

Statistics desire "in this information retrieved which applies to the analysis method. information transformation – on this step summary or aggregation; operations are carried out so that records are transformed or consolidated into suitable for statistics extracting" [22], [23]. Mining Statistics - Statistics styles desired in this system are extracted using smart techniques [24].

Evaluation of trends-identification of thrilling trends in this method that reflect information focused on a few desirable steps [23], [6]. Information presentation - in this device mined information is obtainable to the consumer by way of the use of visualization and information instance techniques [3], [25].

Wide-range sensors have become almost synonymous with the IoT, but some Carnegie Mellon University researchers say the best is wide-range sensing with one multi-purpose sensor per room [11], [6]. The sensor package they monitor monitors a range of events in the room, such as sound, vibration, heat, magnetic field, and noise. With the help of machine learning techniques, this set of sensors can determine whether the right or left water tap is open, know the state of the 'microwave' door (open or closed), or know the number of tissue paper pulled [12], [13], [26].

Including the concept of the Internet of Things in traditional home appliances may change them completely [2], not a requirement to be smart but only to be able to monitor the status of those devices continuously and give them some simple commands through their Internet connection, which will change a lot about its concept during the coming years, adding a small chip Connecting to the Internet may replace a maintenance technician who will spend time finding out the malfunction, so it can turn to see the working records recorded on the Internet, according to the way it works [8], [10].

2. Mining of Data

The centre element within the complete records mining manner is the mining phase [27]. kind, clustering, and wireless rule mining are some types that facts mining assignment can be divided. in the many online, the most classification is the face reputation, catastrophe rescue [28], [26].

Many algorithms use "help perception framework", this sort of shape can now and again produce a few inaccurate outcomes. on occasion a rule's guide and wireless than another implication of regulations is low, however, it may be greater accurate [29], [30]. If we take the assist and set low effect, then we're capable of getting contradictory policies online.

However, if we get those parameters are set immoderate wireless, we will best get the vague guide on online [31]. In quick, nobody to useful resource and a mixture can produce wireless surely correct [32]. Humans thru the have a look at discovered that the exciting, may be used to prune dull guide on online [32], [33]. In elegant, online interestingness is based totally on electricity and predicted actual statistical independence assumption of the intensity ratio [34]. But has been found in masses of packages, as long as human beings nonetheless regard aid as the principle choice set is initially wireless produced factors [35], [11]. So, either to useful resource low wireless in order not to lose any wireless on-line, or take the danger of missing a few essential rules for the former case [28], [36].

In facts mining, the associative class is a promising method and can make use of special extraction from phishing and legitimate websites, wireless. ship and may be attacked by the phishing soft. it can be wireless that phishing assaults appear to be a real organization from the consumer [34], [15]. Via a link in an email and ask them most effective to exchange their information. beneath normal occasions, the two methods which are about the maximum technical in the wireless combat in opposition to phishing attacks are belonging to the blacklisted and heuristic-based absolutely [38].

Anti-phishing technology's that is predicated upon recognizing phishing web sites and deeply thinks approximately the proper time frame [39]. Blacklist is considered to be malicious and collect those eras already in use, such as the user's list of URLs vote [29], [22]. some other technique is based wireless at the contrast on-line through amassing a sequence of net websites traits, the uncovered class set of regulations. all the strategies artwork, they want information mining [40], [41].

"mining of data" gadget and the mining version pattern discovery mode quantity of facts from a capability technique is statistics mining. it is logical database system based envisaged. it's miles a multidisciplinary challenge count number [42], [43]. The approach of crowdsourcing can be used to finish diverse forms of information mining class obligations, together with clustering, semi-supervised studying, wireless rule mining.

The connection of the database's growing is depended on the records mining of the facts base [40]. For establishing the evaluation structures to evaluation, the information set, the sizeable wireless attempt is Wi-Fi wireless manner. In favour, the motive of the constructing the important information set is the collection of the identical vintage tables database, that has to come to be coming together, be joined and converted [30], [17], [9], [8].

It is a great deal facile to produce records than to examine records. The flow of data will actually become big trouble from the IoT [20]. So far, many studies and researches have treatment the problem of inquisitive huge information on IoT [44]. Without an actual and analytical tool, wireless Wi-Fi would be inundated with this incredible amount of knowledge, we and all the systems. while KDD is implemented to IoT, from the mindset of 'hardware', 'cloud calculating' and applicable dispensed generation are the possible answers for massive records; even though, from the mind-set of software program, Maximum mining technology is the layout and developed to work on one tool. In the situations of huge records, it's miles nearly sure that most KDD systems existing nowadays and maximum conventional of Data Mining algorithms cannot be explicitly Wi-Fi for machining huge volumes of the records of IoT [31], [45].

Generally, KDD pre-processing provider or computer information mining firm needs to be revamped for "IoT" wants to be redesigned for IoT that may produce a massive quantity of facts. in any other case, the records mining technologies these days can be magnificently done wirelessly to a compact IOT device that can produce nothing but a small number of facts [46].

To growth an immoderate-average overall performance mining unit registration of KDD for IoT, the three main issues in deciding on the applicable Mining technology for the problems to be resolved via the KDD generation the objective, traits of facts, and algorithm of mining goal: The assumptions, barriers, and measurements of the trouble need to be exact wireless if you need to exactly on-line the trouble to be solved [47], [32], [15], [28].

With these statistics, the goal of the hassle can be made crystal clear data: Attribute records are another critical fact-finding problem, which encompasses length, distribution, and example. Exceptional facts normally want to be processed in every other way [48].

Regardless of the truth that facts pending from diverse problems, for example, (Di and Di), maybe just like each different, they'll need to be analyzed in a different way if the meanings of the statistics. Mining set of on-line with desires (goal) and records wireless detailed above, facts mining algorithm may be without wireless identification. Whether or not to increase a modern mining set of on-line can be wireless thru the use of those elements [49]. For example, one of the characteristics of facts is if the size of the statistics exceeds the capacity of the device and if there is no possible way to reduce the "complexity" of the records, then a unique mining set of rules is finitely wanted; in any other case, the modern-day-day mining set of rules wireless. every different consideration is associated with the goal of the problem itself and the property [48].

If a unique mining set of on-line can decorate the general overall act of a device, then the brand-new mining set of rules is likewise wanted. An example is the online collection group of a sensor network, which you want to call the account payload, however, maximum conventional algorithms of clustering clearly neglect approximately this problem [33].
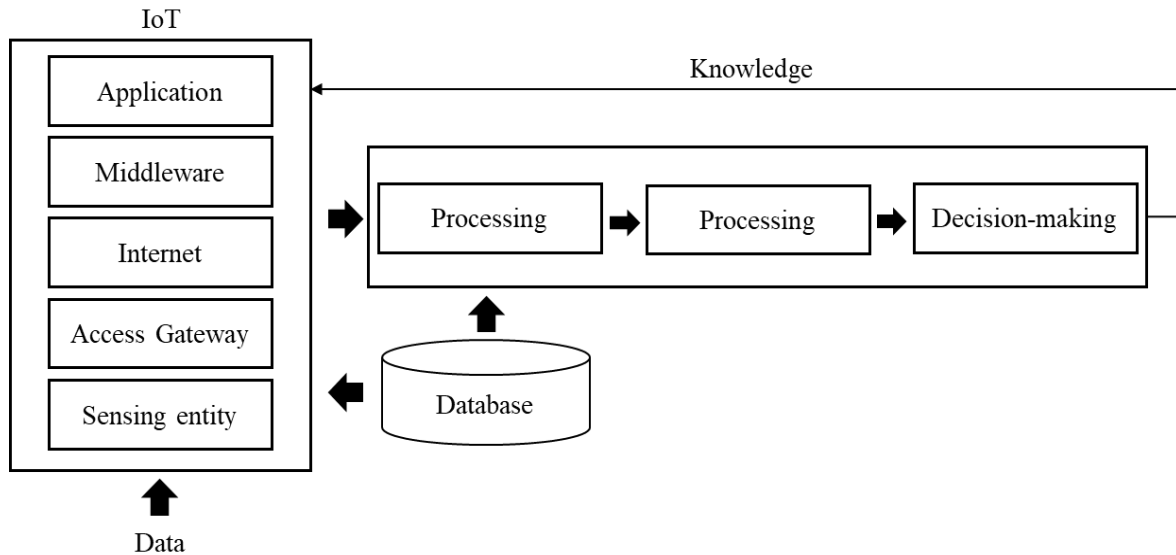
Fig.1 - The architecture of IoT with KDD [50]

3. Classification Process

Simple work step is to tap the unique wireless statistics. step one is to create a separator. The separator can also moreover out online characteristics of the present information. the second step is wireless ally used to categorize [51], [52], [53]. The users on the online can also accomplish the categorization of the wireless. custom client's front net page records aggregator makes use of a Dig, allows customers to submit links classified, make bigger the scope to include extra relevant articles of the consumer may be interested in, we found that the accuracy as increasingly users get involved [51].

The centre set of policies online Agrawal designing is a simple set of rules in 1993, endorse an essential technique of Wi-Fi recommendations mining, that may be a technique based totally on the two diploma frequency set of ideas, the on-line mining set of rules layout is decomposed into sub-issues: It wireless all of the aid is greater than minimal aid of item sets, these item sets called frequency set. The usage of step one to find out wireless the frequency set to supply the favoured rule [54] [37].

The fundamental concept behind classification: as opposed to clustering which assumes lack of early understanding -the way to guide the partitioning technique, magnificence assumes a few preceding understandings of directing the splitting method for wireless fixed assembly to symbolize the potential distribution of patterns [10] [47]. It can be affected understood that category is a "supervised" mastering system whilst clustering is a "non-supervised" studying approach [47].

In mathematical case, the class set of rules can be summarized as follows, given of categorized information; and constant wireless of unlabeled records, the set of classified records is using to teach the wireless [i.e. the hyperon line or prediction feature] even as the unclassified record set; then it will be categorized with the aid of the high-quality [7]. To assess the class results, and intuitive manner is to matter the quantity of taking a look at styles which may be appointed to the right organizations; that is likewise noted to as the accuracy fee) AR (with the useful resource of (AR = Nc Nt), in which) Nc (Refers to the amount of Wi-Fi wireless test patterns assigned to the groups to that they belong) Nt (the range of taking a look at styles [55]. To a degree, the info of the magnificence effects; The " So-called preciseness" (P) is used and is generally not forgotten (R) [38].

Since the point of interest of a typeset of the guide online is on constructing of quality wirelesses that may be used to symbolize the spreading of education patterns which includes how the patterns may be segregated, some of the variations; inclusive of selection tree, "okay-nearest neighbour", "naïve Bayesian" category, "boost" and SVM, had been evolved to assemble set wireless, of better first-wireless [7], [56], [57].

Most of the conventional elegance algorithms; ID3, C4.5wireless, and C5. Zero, is widely utilized in building the choice tree of fine wireless, this is, every branch is representing a check or look at the pattern splitting [58]. which means that the statistics (e.g., entropy and diversity) essential for taking the conclusion tree requirements to be calculated at each new release [59], [39], [60]. In the opposite direction, the complete tree-based algorithms require an algorithm test operator to analyze the factual quality of the patterns of inputs. Within the production section, the wireless node of choice is created completely based on the labelled styles and the contents of the records [61].

After the inspection and building operators get their duties wireless, the selection tree will then be updated. as quickly as the choice tree or -first- wireless become built, within the popularity section, unlabeled enter styles the classes to which they belong are allocated on the basis of the selection tree built in the formation section [61]. Each

input sample is probably allocated to the institution to which it belongs by taking walks from the root of the option tree down to the leaf, i.e. going through all if-then-else checks along the way.

From the choice tree; the naïve Bayesian kind; uses the so-known as possibility model to create the wireless; Those are predicted by the training patterns [59], [61]. The assist vector machine SVM has now developed into a competitive online class collection due to one of the critical "SVM" trends. This means that SVM can lower the wire; separate non-on linearly separable patterns by turning them into an inappropriate position by using the kernel version [20], [40], [62].

4. Classification Algorithms

4.1 Decision Tree algorithm or (C4.5)

An algorithm used to generate a Ross Quinlan C4.5 decision tree is the extension of the earlier Quinlan ID3 algorithm. The decision trees generated by C4.5 may be used for classification. The Weka machine learning software authors described the (C4.5) algorithm as" the landmark decision tree" program which is possibly the most widely used machine learning workhorse in training to deadline [63], [64].

4.2 The k-Nearest Neighbours Algorithm (k-NN)

The k-Nearest Neighbours' algorithm (k-NN) is a non-parametric method proposed by Thomas Cover for classification and regression [1], [65]. In both cases, the input consists of the nearest examples of training in the feature space. The output depends on whether you use k-NN to classify or regress:
- The performance is a class member in the k-NN classification. An object is categorized by a majority vote of its neighbours, assigning the object to the most common class of its nearest k neighbours (k is a positive integer, usually small). If k = 1, the object is simply allocated to the nearest single neighbour's class [66].
- The output is the property value for an entity in k-NN regression. This value is the sum of the nearest k neighbours' values [66].

4.3 The Support Vector Machine (SVM)

The Support Vector Machine (SVM) algorithm is a popular machine learning tool which offers solutions for problems with classification and regression [66]. Developed by "Vapnik" together with colleagues (Boser et al.) at AT&T Bell Laboratories, the SVM training algorithm generates a model that assigns new examples to one or the other group, making it a non-probabilistic binary linear classifier (although there are methods such as Platt scaling for using SVM in probabilistic classification. An SVM system is a description of the examples as space points, mapped in such a way as to distinguish the examples of different categories by a simple distance that is as wide as possible [67]. Then, new examples are mapped into the same space and predicted to belong to a category based on the side of the gap they fall into.

4.4 The Apriori Algorithm

The apriori algorithm is a method for regularly set object mining and pattern classification learning about relational database systems; It continues by defining the common individual items in the database and expanding them to larger and larger item sets, as long as those item sets appear in the database regularly enough. Apriori's frequent item sets may be used to determine association rules that highlight general trends within the database [63]. In 1994 "Agrawal" and "Srikant" put forward the Apriori algorithm. Apriori is intended to operate on transaction-based databases [68]. Many algorithms are designed to find association rules in transaction-free data (Winepi and Minepi) or with no metadata (DNA sequence data). Every transaction is considered a set of items (an itemset) [69].

4.5 The AdaBoost algorithm

AdaBoost algorithm Short for Adaptive Boosting, is a machine learning Meta-algorithm invented for their work by (Yoav Freund and Robert Schapire), who received the 2003 (Gödel Prize) [70]. It can be used with many other machine learning algorithms to enhance performance. In certain problems, it may be less susceptible to the dilemma of overfitting than other learning algorithms. AdaBoost is sometimes referred to as the strongest out of the box classifier (with decision trees as the bad learners) [71]. As used for decision tree learning, knowledge obtained at each point of the AdaBoost algorithm regarding the relative 'hardness' of and training sample is fed into the tree-growing algorithm, such that later trees appear to concentrate on more complicated instances to identify [72].

5. Internet of Things (IoT) Application Area

5.1 Smart City Applications

IoT offers smart metropolis services for Governments like surveillance, electricity and lighting fixtures, parking meter, adaptive traffic manipulate, disaster control, evens manipulate, useful resource manipulates and emergency reaction gadget" Smart transport services (such as connected vehicles, fleet management, bridges, rail, port and aviation), smart grid technologies (such as the capacity of power lines, demand reaction), smart water products (such as wastewater and household water systems), Smart infrastructure applications and totally package-based environment (collectively air quality, environmental monitoring, landfilling and waste management) [8]. Statistics produce IoT Devices, via the use of mining these records, we are able to generate meaningful styles [23]. Also, fate incidents can be assumed for automated individual interactions. This is achieved using marvellous and time-collection measurement frameworks to identify virtual systems that are entirely connected based on their use[58]. Facts generated by one's devices can be stored with their relative time intervals, and future events can be predicted by using linear regression in these facts [43].
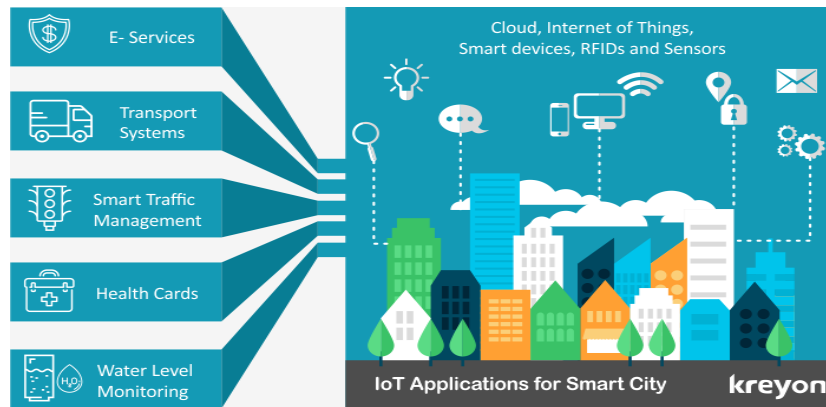

Fig. 2 - IoT in smart city field [5]

5.2 HealthCare Applications

The improvements in IoT systems offerings are apparently more appropriate in healthcare business enterprises [73], [74]. Health Care tool in collaboration with IoT systems provides numerous services for patients, such as frequent blood stress tracking, diabetes, coronary heart load, weight data, and information related to pulse. These varieties of facts are probably saved the on cloud maintained via worried hospital [74]. A smart device has to be superior to mix those divergent statistics and provide accurate information about the individual affected [9]. With the help of text mining, we can study affected person's medical records primarily Based on the prescription of a clinical doctor and conclude on the patient situation. The clustering may be used to remedy the affected case [8], [12].

Fig. 3 - IoT in healthcare field [15]

5.3 Agriculture Applications

In 2050 the global population is projected to hit 9.6 billion [37]. The sector of agriculture will now accept the Internet of Things to sustain this vast population, in order to address threats such as adverse weather patterns, rising climate change and the environmental effects of industrial farming activities [75], [17]. Before it reaches demand for more milk. Smart IoT-based farming can enable farmers to reduce waste and increase productivity [34].

Smart agriculture is a program that relies on resources and advanced technologies to produce food safely and sustainably, and it is the use of new knowledge and communication technology in agriculture [34], [75].

A crop field monitoring system was developed using sensors (light, humidity, temperature, soil moisture, etc.) in IoT-based smart agriculture. Farmers can monitor the conditions in the field from wherever IoT-based smart farming is highly effective compared to traditional farming by simple means [34], [57].

IoT-based smart farming technologies are not only targeted at large conventional farming activities, they may also be new ways to improve other growing or similar agricultural developments such as organic farming. Regarding environmental issues, smart agriculture Will offer great benefits for more effective use of water or improving inputs and treatments. Now, we show you the most important major applications of Internet-based smart agriculture that will revolutionize agriculture [56].
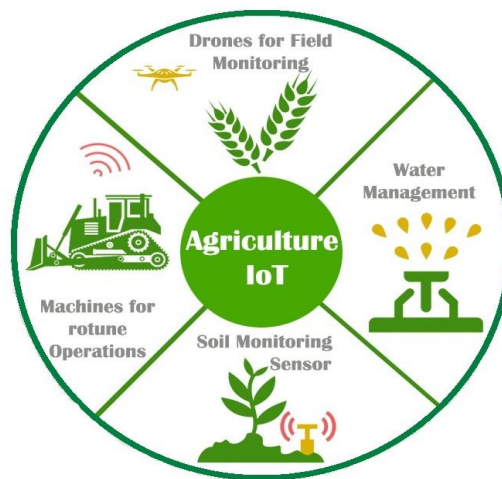

Fig. 4 - IoT in agriculture [75]

6.   Literature Review

6.1 Smart Environment Field

IoT devices or things including smartphones, vehicle sensors, GPS are used anywhere in the city can serve as data factors along with travel time, the occurrence of heavy vehicles, on-line accident zones and creation areas. Cognizing the causes of Wi-Fi obstruction in the defined vicinity is the notion with the aid of these elements of records.

To solve the traffic congestion problem, Sundaresan et al. [76] their study confirmed existing smart home jobs to understand human event activity. This type of Smart-Home contains many sensors and internet cameras to reveal the smart home space. The existence of infrared cameras, microphones, or even portable motion sensors is used to gather surveyed field statistics. Likewise, to wirelessly communicate with activities (such as showering, dressing, and using the restroom) and merging information about the surrounding area; From a kind of tool (for example, Extracting Camera and Sensor functions), the overall performance of the class algorithm; It may also affect the accuracy of this type of device.

Bhatia & Patewe [27] They used a set of rules. The chosen areas should be classified in a specific region, focused solely on the highest, lower or medium risk of wireless jam incidents. For the anticipation of an afternoon's period in which the obstacle should take effect at the maximum pace and, utilizing the refinement strategy, the road that has no traffic blockage used to hit the holiday spot. To avoid congestion, the kind will disperse the traffic.

Although recent work has indicated the huge potential of crowd sensing for possible traffic density identification, its applicability is currently restricted to particular scenarios. Haferkamp et al. [77] proposed a driving force steerage device Changed to developed by combining position details given by GPS, car monitoring geographical statistics and special data that can be obtained from the internet to forecast the destiny scenario. This type of machine then uses the decision tree magnificence set of rules to expect and advise the direction of routing for a purpose force, based mostly

on real-time facts, historical data, and so on. Another problem is to spend a large amount of time searching for parking nearby.

In addition, the road markings extracted by Wen et al. [78] are classified by constructing a sequentially defined decision tree, based on engineering parameters (e.g., perimeter, area, and calculated width). The laws will clearly define complicated road signals, such as terms and arrows, but this current approach is challenging.

Rigatos et al. [79] generated sensors to find the parking vicinity, Wireless to car parking area control devices, including pressure sensors and video cameras. Tariq et al. [80], a traffic method used the so-referred to detect the movement of cars as a passive infrared (PIR) sensor based on the information that comes from each internal and external node to categorize cars that join or exit depending on the wide range of vehicles located within the parking lot. in addition, the offered method moreover integrates the short message provider (SMS) IOT with the car parking zone tracking machine to send the provided information to the person who desires a parking area.). Chin et al. [5], secured Internet of Things devices to smart cities from fraud and intentional attack by using the random forest classification algorithm with an accuracy of 93%.
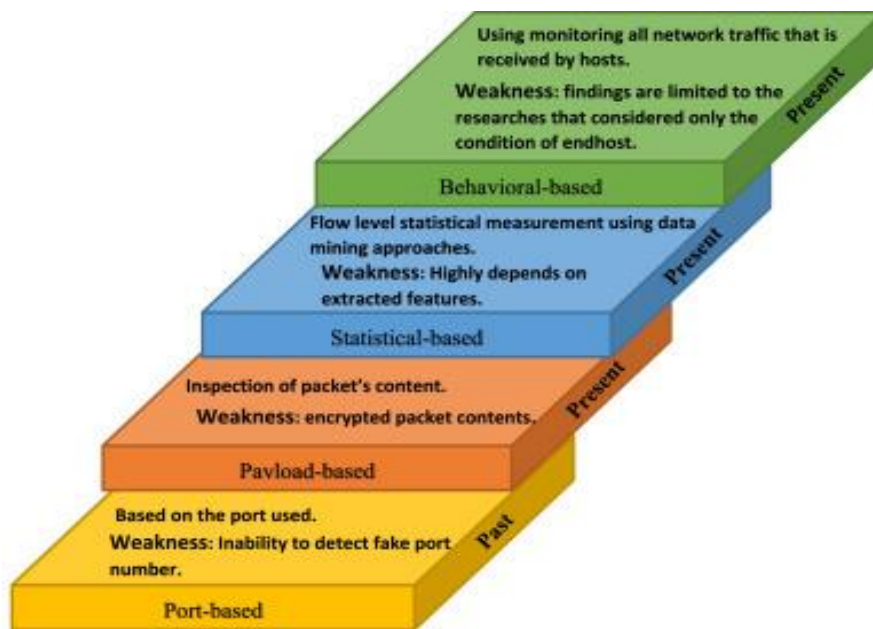

Fig. 5 - The rise of traffic classification in IoT networks [24]

6.2 Healthcare Field

As the internet of things increases in medicine, there are challenges related to safety and privacy. To facilitate full reliance on the Internet of Things in the healthcare field, it is important to identify and analyze the salient features of the Internet of Things related to safety and privacy, including safety requirements, vulnerabilities, threats, and countermeasures from a healthcare perspective.

A real-time health tracking device named Healthcare Industrial IoT (HealthIoT) was proposed by Hossain and Muhammad in [81]. This method has a great ability to evaluate the health care records of patients and mitigate the conditions of death. This IoT healthcare system utilizes medical tools and instruments to collect medical records.
Prabal Verma and Sandeep in [41] proposed SSIS is a patient-centric approach to draw results from data collected by medical sensors for continuous well-being, monitoring and maintenance.
The diabetes diagnostic output of BMI has been observed to decrease with rising age, except for people in their sixties Sridhar in [66], noticed that the Artificial Neural Network with a 97.44 per cent accuracy rate had the highest results on the chosen dataset. Accuracy rates are 81.19, 95.03, 90.85, and 91.60 per cent respectively for supporting vector machine, decision tree, 5- nearest neighbour, and Bayesian network.
Jagadeeswari et al. [9] The Social Network Analysis (SNA) diagram for infected users and mosquito breeding sites was generated. The program utilizes aggregation of knowledge and primary function for sharing to prevent unauthorized access to records and to maintain protection. We used machine classification algorithms such as Naïve Bayes, Fuzzy C-means, Fuzzy neighbour K-nearest and Neural Network. The fuzzy C-means, as seen by the method, generate high accuracy relative to all other algorithms of classification.

But innovations in the IoT are still growing in this direction, Saraswati et al. [82] They invent patient follow-up by monitoring the activities of elderly individuals in their homes or nursing homes and hospitals by collecting patient data Telemetry here collecting vital signs, EKG statistics, etc. by using classification algorithms.

Bifetet al. [8] use different algorithms to classify chronic diseases and determine the appropriate treatment. Pererain [83] also suggest a wearable device-model for chronic diseases, such as blood pressure, heart rate, and blood sugar level. This device stores data collection, the algorithm used for data is the random forest classification with an accuracy of 91%. However, the classification of the large data set was not clarified in this paper because these devices produce a huge amount of data.

Varatharajan et al. [84] apply different classification algorithms to extract data on 3 sensory data groups that were collected by patient-sensing devices such as SVM, K-Nearest Neighbor, NB, C4.5, ANN, deep learning, linear discriminatory analyzes, C5.0 for the Internet of Things More Intelligently, it was stated that the two algorithms (C4.5 and C5.0) are more accurate than the rest of the algorithms mentioned above.

One of the common diseases these days is "stress" [85]. It is a common problem for many people that may cause stress with serious heart diseases. Therefore, researchers designed a device that monitors heart signals ("ECG") applied to truck drivers, because they spend long periods in driving and this research has achieved levels of accuracy "Low", "Medium" and "High" by using "Random Tree" Classification, the model shows the highest accuracy which is 70.50%. There are a lot of other algorithms used to classify data on the Internet of Things in the field of health care.

6.3 Agriculture Field

Megan et al. [86] provide a model for the prediction of a recommended weekly irrigation plan to improve soil moisture probes and improve the simulation. Soil moisture technology provides full local agricultural support during the season, and recommendations to improve efficiency in water use. The professional virtual optimizer combines different water management technologies in one central location. By distributing several sensors in three farms that collect data about the nature of the soil in those farms and weather conditions, they got an accuracy of 90%, and this does not mean improving the farms because they depend not only on dust, but the weather factor also plays a big role in this matter.

Muangprathub et al. [34] propose the creation of an optimized watering device for farm crops focused on a wireless sensor network. The company is designing and implementing a control device that uses node sensors in the crop region, with mobile and web application managing data. The three elements are the "devices", "Web", and "Mobile". Soil moisture sensors, connected to the control panel, are being used to track the area. Sarangdhar et al. [87] suggest "Mark2" sensor for weather monitoring and crop monitoring, and a solar-powered irrigation management tool, featuring more than 30 original sensor enhancements, including enhanced sensor accuracy, extended cellular connectivity, extended battery life, and UV-proof paint to withstand extreme temperatures and extreme conditions.

In addition to the intelligence generated by sensors, Suresh et al. in [88] connect and render more accessible by common third-party sensors. One of the greatest problems of agricultural technology is that there are a number of disconnected devices to use, thus placing all the key data on the growing season in one place; By linking its data with sensors, such as soil moisture sensors and irrigation flow rate sensors, the purpose is to simplify the sector, data on improved decision-making and cost reduction to detect diseases of cotton leaves with an accuracy of 83.26%.

A model was proposed by Haseeb et al. [75] to collect data on the principal soil nutrients such as nitrogen, phosphorus and potassium, as well as collect the pH value and humidity level by using soil diagnostic sensors to grow walnut trees. For this model, 1000 samples of data were used to test the appropriate type of classification for application. This model helps the country to improve production, reducing time and cost. In this field, many researchers discussed and classified agricultural diseases with high accuracy of up to 89%, and some of them discussed irrigation problems and designed another high-precision model of 95%.
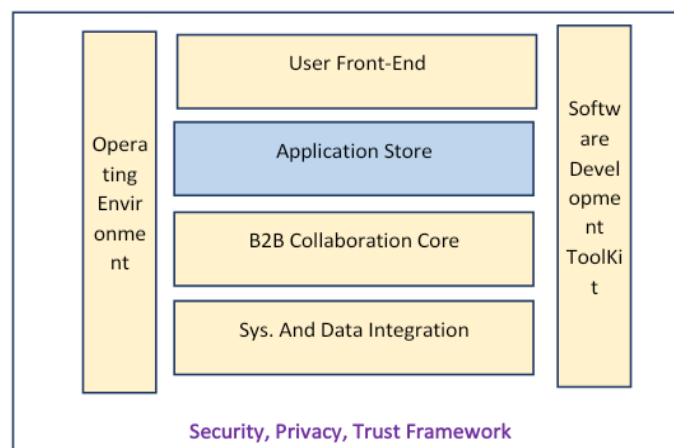

Fig. 6 - The classification of "IoT" in agriculture [32]

7. Experimental Studies and Discussion

In this paper, several classification algorithms have been reported in the literature of the IoT Classification Methods with a spotlight on the important pros. and cons. of each reviewed method, this section is a discussion about the classification methods on different applications where the IoT is used. As shown in table 1, It can be seen in the field of smart environment, the [20] showed the most accurate algorithm with the accuracy of (99.69%). While (71.75%) accuracy value can be seen in [80] for a healthcare field system. Finally, when comparing the accuracy of the algorithms used in the agricultural field researches the most accurate value in [86] was (93%).

Table 1 - The pros. and cons. of the classification methods

Ref.	Publish year	Segmentation methods	Accuracy Rate	Description	Pros	Cons
[10],[8]	2019-2016	Sampling	RFID=90% Accuracy= 97.38%	Selecting a Data Underlay for analysis	Guaranteed error limits	Weak for finding an anomaly
[89]	2015	Shedding Load	Accuracy=98.5%	Ignoring a mountain of evidence	Efficient for Questions	Really bad at identifying phenomena
[86]	2019	Sketching	Accuracy=93%	Random projection on function set	Extremely Efficient	Can neglect features appropriate
[13]	2016	Synopsis Structure	Accuracy=40-60%	Fast Convert	Analysis Task Independent	Not enough for very good
[90]	2017	Aggregation	Accuracy=75-95%	Compilation of factual summaries	Analysis Task Independent	Can neglect pertinent features
[6]	2015	Approximation Algorithms	Great accuracy	Algorithms with functions error limits	Efficient	Adaptability to resources on usage level can't always be
[78]	2018	Sliding Window	accuracy = 90.00%, 88.00%, 95.00%, 82.00%, 74.00%, 80.00%	Analyze much recent outlaws	General	Part of Ignore From stream
[35],[80]	2020 2019	Algorithm Output Granularity	Accuracy =36%-71.75%	Extremely resource-conscious memory and Sch-winging data speeds	General	Overhead cost Resource Conscious Products
[20],[21]	2019 2019	Classification and Clustering, Spatial Data Mining	high accuracy up to 89% accuracy=99.69%	Any type of approach to mining Parallel application in high degree results	asper requirement needed to raising parallelism	Inability to process heterogeneous data

The world seeks to invent devices and systems that can be self-reliant in the implementation of business and tasks, and one of the ways to make the system smart to become close to human thought is by using data mining technology. The world has come a long way in trying to make computers think for itself to develop high-performance performance, which is the Internet of Things system using data mining methods and techniques, and this cuts down a lot of work on humans.

In this paper, we talked about some important applications in the daily life of a person, on which the state depends greatly, which are three important areas (in the field of health, agriculture and the environment), this paper talks about how to categorize the big data for the Internet of things used in the mentioned fields, the classification methods used and the extent of The accuracy of the algorithm used. We have seen in previous research the use of different methods of

classification and each method has its advantages and disadvantages and their accuracy and was mentioned in Table 1 it was shown that the best classification algorithms used that come with high accuracy are the SVM algorithm, random forest.

8. Conclusion

In this review, the paper analyzed the related work and applications of statistical and data mining technologies to the IoT, which involves the development of clusters, groups and specific types of mining, from the sub-structure angle and the providing attitude. Assessment and discussions are also given on the scale of each data mining method and the overall integrated device. To make it harder for the paper's target audience to grasp thoroughly the changes made to the IoT tool, a dialogue is given, ranging from the account of the IoT to the promise of the mining age to the transparent problems that we are going through these days. As the production of the IoT remains at the early diploma of Nolan's gradual level model, nine it is also the case that it is easy to upgrade the pre-dispensing tools and render the "IOT" gadget capable of handling huge details, after which at the improvement of powerful mining technologies to wireless discover the guide on online to explain the data of IoT.

The problem wireless to surface in the development of records mining for IoT is a way of summarizing and constituting the mining effects from the attitude of Nolan's incremental model stages. A few factors to help the paper wireless audience proceed, this paper summarized that there is wireless in any respect that huge information is the future fashion due to the fact maximum when all the resources no longer apply documents to the database as often as they become network connected.

IoT also inherits various signal processing problems from present statistics mining research; in particular, statistics; fusion; the abstraction of facts; and description of information. Managing the flood of large records, generating samples, generating compression, increasingly getting to know the era; and filtering the era will all become more important while using data mining technologies. To evaluate IoT documents, Ontology and semantic internet technologies have certain viable approaches to their problems; however, they are unable to solve such problems since they are not advanced. Strong furry decision and multipurpose processes have the capabilities to allow a sensor to make selections with the useful resource of itself. as a result, we do trust that one's technology may be the fashion of information mining technology for the IoT.

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