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red@devlart.hu

CONTENT

The relationship between human intelligence and artificial intelligence II.

Imre Négyesi, András Fehér
National University of Public Service, Hungary

Abstract

Artificial intelligence (hereinafter referred to as 'AI') as a technology can accelerate the innovation and development of military research. AI is an extensive technology that is connected to other disciplines as well (psychology, cognitive science, information science, systems science, biological science, etc.). Its extensive nature makes it suitable for use in military applications.

Keywords: Artificial Intelligence, Artificial Intelligence Application, Military Artificial Intelligence

Introduction

In the first part of the article, we examined the relationship between human intelligence and artificial intelligence. Having established that MI follows human intelligence, it has also become apparent that the technological classification of intelligence can be applied to AI as well. In the second part of the first chapter, we summarized what search solutions, inference methods, and control strategies we can apply to AIs. In the third part of the chapter, we examined the possibilities of machine learning. Our findings provided the basis for further investigation of military AI systems, which we continue in the second part of the publication with the possibilities of task automation and the relationship between automation and AI.

Automation and autonomous systems

Evidently, there are many similarities between human intelligence and artificial intelligence (including military AI), but there are some differences as well. Each autonomous system that has any kind of interaction in a dynamic environment has to create a world model which then has to be updated continuously. This means that users have to collect information on the world with cameras, microphones and/or tactile sensors, and then reconstruct the information so that the computer "brain" has an efficient and updated model before making any decisions. The key to an efficient autonomous system is having timely updates and the accuracy of the world model. Conceptually, autonomous systems will include AI technologies such as visual perception, speech- and facial recognition, and decision making.

To better understand the layers of AI, it is important to understand the difference between automatic and autonomous systems at first. Automatic system is a system in which a computer is working which is justified by a clear, rules-based structure, and it works in a deterministic manner, i.e. every input results in the same systematic output (except when something fails). An autonomous system is a factor that justifies the set of inputs with probability, i.e. it creates suggestions on the best possible actions during the input of sensor-data. If the same input is provided for an autonomous system multiple times, it will not necessarily result in the same output in every case – contrary to automatic systems –, because autonomous systems can result in various outputs.

Automation of driving is a quite recent invention from the second half of the 20th century. Its foundation and essence were both expressed by the scientific and technological revolution. Quality change in "man-machine" systems has happened when technical equipment that are more efficient in performing the basic functions of human activity or production were developed. This was considered

the first step in the modernization of "man-machine" systems, i.e. the start of automation. Accordingly, with regard to the military field, contemporary principles stated that automated troop control systems include the command systems of subordinate military organizations (formations), their armaments and technical equipment, including automated and automatic control systems for their combat arms. We can see that the range of technical equipment of automation has been interpreted quite broadly, which is also shown by the following categories, according to which the following technical equipment could be used in automated troop control systems:

— Intelligence gathering equipment (aerial, radio, radio-technical and other reconnaissance);

— Data recording devices (perforators, typewriters, printers, tape recorders, dictaphones, copiers and duplicators);

— Data processing equipment (tabulators, calculators, electronic computers);

— Data converting devices (reading and encoding equipment, converters, devices creating and reading microfilms);

— Information exporting equipment (automatic printers, electronic panels, screen displayers, graphic drawing machines);

— Information retrieval and storage tools (card indexes, document sorting equipment, special high-capacity information and multi-purpose electronic computers);

— Communication equipment (telegraph, telephone, radio, radio relay, telecode equipment, commutators, selectors, document transmitting (photo telegraph) equipment, pagers for the leading staff).

The division into specific tasks enabled both the preparation and future implementation of the targeted developments. Based on this, the following key functions of automated troop control systems have been identified:

— increasing the effectiveness of combat arms;

— more economical use of destruction devices;

— increasing the protection of own troops;

— increasing the commanders' and military staff's efficiency of creative activity;

— providing commanders and military staff with information reflecting the situation;

— operational improvement of leadership;

— improving cooperation between and within executive bodies.

Besides defining the principles, decision makers also paid attention to specifying the practical implementation. They have come up with several options for the implementation of automation:

— autonomous (local) application of automation tools among military staff;

— setting up independent automated systems for the various formations;

— creating a complex automated troop control system.

The starting point was when the two fundamental tasks related to the modernization of the troop control system and its processes have been determined, and it has been stated that modeling and formalization will play a key role in the process of automation and optimization of troop control. The fundamental tasks were the following:

— creating the necessary conditions and technological tools that can provide highly operational control;

— making control activity more efficient, particularly by increasing the soundness and accuracy of decisions.

Diving the tasks to peacetime and combat leadership tasks was the simplest solution. Computers were used for a variety of tasks during peacetime leadership of troops:

— developing the main structural concepts of the armed forces;

— preliminary assessment of the operational plans of combat leadership, and modeling combat situations based on the assessment;

— tasks related to ensuring the combat readiness of the troops;

— planning and implementation of mobilization;

— preliminary assessment of the combat capabilities of the presumed adversary;

— evaluating the existing armaments and developing requirements for planned equipment;

— performing controlling-financial operations.

The future of AI in military systems is directly related to the ability of engineers to design autonomous systems that demonstrate the independent ability of knowledge-based and expertise-based reasoning. Currently, such completely autonomous systems do not operate. Most robots are remotely controlled from the ground, which essentially means that a human still directly controls the robot, just a little further away, like if they were doing it through a virtual extension cord. Most military unmanned aerial vehicles (UAVs) are autonomous to some extent which allows them to navigate without human intervention, but almost all of them require significant human assistance to perform their missions. Even aircrafts that fly over a target to take pictures and then return to their starting location on their own still operate on an automated and not on an autonomous level, and are not “real” autonomous systems during the flight. Although current operating systems are automatic

rather than autonomous, there are significant global efforts to research and develop autonomous systems. In the development of such military systems, progress is being made in many countries in connection with aerial, ground, water and underwater vehicles, with varying degrees of success. There are already several autonomous helicopters that can be controlled by a ground soldier with a smartphone, and these are under constant development in the United States, Europe, and China. Autonomous ground vehicles (AGVs) such as tanks and transport vehicles are evolving worldwide, as are autonomous underwater vehicles (AUVs). Agencies developing these technologies struggle with operational implementation in almost all cases. There are several reasons for this, for example the costs and the unforeseen technical issues. Organizational and cultural differences between developers also pose a problem, and these differences can become barriers on their own. Highlighting an example, the U.S. Navy's X-47 was developed as an autonomous combat/bomber aircraft, but despite many successful naval trials, it is now planned to be operated as a tanker for aerial refueling which is far from its original (achievable) purpose. Many people in the military accept only the supportive role of UAVs, but in their opinion, they jeopardize the status quo if allowing the most prestigious, "spear-type" tasks to be undertaken by machines. However, there are other organizational issues that limit autonomous systems, and the shifting of advanced development from the military to the commercial environment is becoming increasingly problematic. The development of military autonomous systems is at best slow and complicated, and thus it lags behind the progress made in commercial development. Improvements have certainly been made, for example, in the case of driverless cars in the framework of the Defense Advanced Research Projects Agency's (DARPA) program (2004). When the program ended in 2007, the results showed that driverless cars could only move slowly, on closed tracks, and not without accidents. A decade later, the development of the industry has reached the threshold of placing driverless cars on the market around the world. This quick progress has been supported by research and development investments from a major industrial sponsor, as well as the competition for billions of dollars, and the growth of the automotive consumer market. Meanwhile, there was little progress in the military autonomous vehicle development. The military is unable to further develop its autonomy program, not only on the ground but also in the air and other areas. Progress has been made in three key sectors: flying and space protection, automotive industry, and information transmission, i.e. communication. These sectors are essential for the development of autonomous systems and thus the monitoring thereof. Expenses provide insight into the speed and extent of innovation.

Military decision making requires more and more capabilities, and more information is required from the battlefield. As the military becomes a network, decision makers have to choose and effectively filter information on the battlefield in a timely manner as well. Human capabilities are no longer enough to analyze all the data because there are quick, dramatic, unexpected movements on the modern battlefield, and chaotic and nonlinear situations can recur. Artificial intelligence allows a wider range of possibilities to be explored, allowing staff to analyze additional potential options and to analyze these options deeper during the same time interval.

To summarize, the military planning process typically consists of the following steps, all of which can be supported by AI:

- initiation, meaning initiating the mission and receiving the task;
- orientation, including mission evaluation, mission statement, and the decision maker's planning guidance;
- development of a concept, including analysis of friendly and hostile forces and decision making estimation;
- making a decision, including selection of the implementation method, approval of the action, and review of crucial points;
- development of a plan, including mainly synchronization and finalization;
- plan review, including analysis and revision of plans.

Militaty deelopment trends

We have witnessed significant changes in seven categories of technology. (These categories are chemical sensors, biological sensors, radio communication, laser communication, radio-frequency weapons, nonlethal weapons, and biological weapons.) The remaining categories of key military technologies, many of them using sensors or major components of weapons platforms, seemed likely to advance at only modest or moderate rates. (For example, ground combat vehicles, aircraft, ships, and rockets.) In my concurrent paper, I revisit these prognostications one by one. Crucially, however, putting aside robotics, any of the remaining areas of technology did in fact undergo revolutionary change.[1]

In the future, any conflict is likely to take place on a battlefield created by artificial intelligence and other new technologies. Some suggest that this change will be so revolutionary that the leader of artificial intelligence will rule the world, and that wars may soon take place without the involvement

[1] Michael O'Hanlon: Forecasting change in military technology, 2020-2040

of humans. While believing in the transformative potential of technology is tempting, hoping that robots will completely replace humans in war is wrong. However, human innovation has already overcome the technical disadvantages to lead those who exploit the battlefield the quickest to victory.

Intelligent and increasingly autonomous systems are already replacing and exceeding the capabilities of human forces. Autonomous systems to date have been rather limited, using fixed sets of rules and different levels of, but not direct human control. The increased use of AI enables autonomous systems to become more significant in sophisticated decision making and self-directed activities while creating more and more complex human-machine cooperation. Autonomous agents provide rapid analysis, advice and courses-of-action for strategic-operational-tactical planning which allows increased OODA[2] loop effectiveness and brings an entirely different perspective on old problems unconstrained by old strategies. Such intelligent military networks have the potential of increasing decision speeds to such levels that will require new methods of human-machine interaction and visualization. The competition between combat networks will generate increased evolutionary pressure on algorithms, each seeking effects that will lead to a decisive victory. Similarly, approved autonomous vehicles will increase their effectiveness across the conflict spectrum, creating large sensor networks.

Developing agile and adaptive mesh C4ISR[3] networks is the second military development trend. This increased reliance on seamless and ubiquitous connectivity increases the performance of networks in disinformation activities. Such attacks shall be implemented long before the conflict itself starts. They could strike at modern operational and strategic staff, information, financial or other supporting elements indirectly, from a logistical point of view.

As the operational environment expands to include space, cyber- and the broader information sphere, the need to think, plan and operate in a widely dispersed, interconnected and multi-domain manner will become even more critical. The growing numbers and wide distribution of multi-domain sensors and multi-domain networks present more and more integrated, increasing processing capabilities for dominance, counter-domain capabilities, protection, counter-measures, and other secondary functions. The increased exploitation of new domains will inevitably lead to the search for domain superiority, with attendant costs and capability requirements.

Summary

[2] Observe-Orient-Decide-Act
[3] C4ISR Command, Control, Communications, Computers (C4) Intelligence, Surveillance and Reconnaissance (ISR)

Technology can really help in winning wars, and AI has important military potential. However, if technological developments are so often overcome by tactical innovation, then technical developments will only be considered “helpful” and “good to have”, but not a necessity. Accordingly, tactical innovation of military AI should be given the same high priority as innovation of weapons systems. On the one hand, this requires greater investment in virtual training capabilities and capacities, and, on the other hand, a reduction in the number and intensity of operations is necessary to put more emphasis on preparing for future combat. From an American perspective, this means that the U.S. share of military commitments in Syria, Iraq, and Afghanistan should be significantly reduced so that U.S. forces can prepare for the next war instead of fighting. In addition to developing military artificial intelligence, the military needs to invest in a more powerful virtual training infrastructure that can align soldiers, sailors, flying units, marines, and astronauts with common tactical challenges that they might have to face in the future. At the same time, there is a risk of overestimating the rate of technological change and the role of advanced technologies in the hope of future victory. While pursuing technological advantages, the military should remember lasting truths about warfare. The layers of force employment are key to any battle, and an overemphasis on technology carries risks that allow our future adversaries to take advantage of our weaknesses.

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Examining large-scale victories based on several aspects in European football leagues

János Tóth jr., Zalán Vereckei, János Tóth

University of Physical Education Budapest, Hungary

Abstract

This research's goal was the examination of the large-scale football matches in the highest ranking leagues by UEFA, which are the spanish, the english, the german, the french and the italian first leagues. By analyzing the course of the formation of the matches, I examined that, in which section of the season it develops, in which half, if it affects the home or the visitor play, and in which country's league are the most and least typical these matches. During the research I examined matches' data between 1995-2018, altogether I examined the results of 2029 football match, which data were from the Kaggle database. The analysis showed, that the 52,75% of the large-scale wins are already develops in the first half, and in 74% the home team can score 4 or more goals and win. More interesting, that between the leagues there aren't any deviation of the goal differences, on avarage it's everywhere 4,46 goal difference in favor of the winner team. A victory with a large-scale end can happen with the same chance in every round of the season, except the last four games, which probability is 0,04%. During the examination I found out, that in 91,4% the team who was in advantage in the halftime, was the winner in the end. These results are the most likely to heppen in the spanish league and the least likely in the italian league. Based on the research results, we can say that in the highest ranking leagues by UEFA, typically the home team can win with a big goal difference. This supports the comments made so far in the literature about the advantage of the home pitch. As no study was performed before about the large-scale matches, so it's enriching further the subtances about football, thereby giving space for other researches in the academic world and a new tactical preparation for the clubs.

Keywords:

Introduction

When we talk about a football match and it's final score, there is much more effect coming from the location, where the match takes place, than we first think. Even before the first whistle and the starting kick-off we can already calculate with the fact, that the actual pitch is going to give preference to one team and disadvantage to the other. Numerous publications have been produced among studies in football analysis with the purpose to specify and characterize as accurately as possible the measure of this preference and disadvantage. After the different research based on conditional and technical examinations so far, I would like to expand the discourse about the prefernce of the home pitch. This study of mine is going pay attantion to a new topic, which is the phenomenon of the matches with a large-scale ending, the analysis and the characterizes of them.

My research is focusing on matches in the five highest ranked league by the Union of European Football Associations (in the following: UEFA), which are the english Premier League, the french League Un, the german Bundesliga, the italian Serie A and the spanish Primera Divison. I'm going to research the matches in these leagues, which are ended by four or more goal differnce.

I performed my research of the examination of the hypotheses with measurements, which are based on the analysis and the comparison of the five leagues, so the results are give space to define the similarities and the differences between the leagues. I'm going to draw a conclusion about the emergence of the high goal number matches relying on the former literature and the results of the statistic analysis. These can be traced back to more factor, for example mental and physical tiredness, psychological effects or the impacts of the local supporters on the players or the referee. By the results, we can get closer to understand what's behind these results with high goal differences. The results obtained from the research helps to know how in certain match situations it's worth to change on a given team in order to reduce the difference and change the result in a positive direction in favor of the losing team.

In my opinion, the final score not only depends on the players. There are nomerous external factors, which are plays a role, so by examining these, we can help the preparation of the coaches and players. As the literature has not dealt with -to my best knowledge- the matches with big goal differences, reasons for its occurrence and the connection between the result and the home pitch, so my results and findings can be a useful part of the preparation for the teams in the future.

In the first chapter of my study i'm going to base the investigation by overview the relevant literature, summed up the statements so far about the preference of the home pitch. After this i'm

going to introduce my hypotheses and the research quiestion related to them. In the third chapter i'm going to characterizes the database used for the analysis and the applied research methodology, the statistical surveys, with which i got the results described in the fourth chapter. I'm going to show a comprehensive picture of the matches with big goal differences, the factors contributing to the development of them and the genereal characteritics by detailing my results separately. The fifth chapter is summarize the results of the research and draws conclusions in the view of some countries' leagues, players and the fans.

Literature review

Nomerous studies, that researches football, focuses on what preference can be made by the home pitch, or what disadvantage can be for the visitors by the place. The published articles are arranged on the same topics, so for example we can find works about the positive psychologic effects of the home pitch [1], [2], [3], about the physical and mental tiredness of the players [4], [5], [2], [6], as well as about the effect on the referees' decision making system by the local fans and the location [7], [5], [8]. These are stretching back in time, but the subject still concerns many people today, so a really interesting and meaningful literature has accumulated about this topic. As an example of previous research, Richard Pollard has already examined in an article in 1986 the preference of the home team in England and North-America, in which he found, that for the english teams the victory rate of the home teams has changed just a little, since the start of the english champoinship in 1888. He also noted, that football is the only one among all sports, in which the location and its positive effects are always very important. By that he was referring, that even before the start of the game, the location is decisive. As a reason for this, he listed several factors, like the local fan base, the tiredness from travelling, knowledge of local conditions, the partiality of the referees, special tactics from the site and the psychological effects. [5] By the help of Pollard's article, we can lead back the positive effects of the home pitch as a research topic all the way back to the 19th century.

Although his article can be said to be old, we can see many of his findings in fresher studies. Numerous researches has been done about the positive effects, which are influance the final score by the home pitch and other factors attached to it. After almost three decades, Marc Allan and Mark Jones authors give a similar, comprehensive picture in their article, in which they are sum up more researches about the preference of the home pitch. The analysis of the psychological effects is a matching point with Pollard, in connection with which Allen and Jones names two types of models. According to the work of the followers of the standard model, the authors separate 4 factors. The

tiredness because of the travel, the pitch knowledge, in some sport, the favorable competiton rules for the home team and the support of the home fans and the possible effects of the judgement and decisions of the referees. The territorial model, as a name, also refers to those factors on it's behalf, which are triggered by a thought according to the team in this case is protecting it's area by the protection mechanism. [9] This theoretical branch is invastigates the efficiency of the home players along to the rise of the level of testosterone and cortisol. Allan and Jones related to the topic, they invastigate more positive effects of the selection of the red jersey in the Premier League in another article, although they can't substantiate significantly this in their article, the advantage of the home pitch was confirmed. [10]

By unfolding the four factors identified by Allan and Jones and focusing on football among all sports we can learn more about the importance of the place where the match takes place by the following studies. Roman Gauriot and Lionel Page are investigate the so-called psychological momentum, which can develop by a goal, scored before the half time. Although this assertion cannot be supported, their article's relevance is lies in the attainment of the psychological dominance, within that the emergence of the dominance in the first half and in detail it's effect for the present research. According to Gauriot and Page, an action is the right moment, a positive moment is projecting ahead and beneficially effect, inhance the future performance. This is path dependence and the document leading to path dependence, which can determine the dynamic of the match according tot he authors. Scoring a goal evokes positive emotions in the player and the team, which scores, at the same time it causes stress in the opponent team, which can seal the strategy of the game together. [11] Gauriot and Page, for these reasons are focusing on the time the goal is scored, but further raising their thoughts regard to the high goal difference wins the psychological moment, which is in our present case the formation of the high-difference superiority, and the emotions will be important evoked by it.

Carlos Lago-Penas and his authors are investigating in the issue of the psychological moment, focusing on the importance of scoring the first goal. They evince by statistical calculations, that in the european leagues the home teams scored the first goal in 54.8% and they win in 84.85% of these matches. They confirm the effect of scoring the first goal by these results as outcome predicting factors in the European elite leagues. They justify this with the fact, that football is a low-scoring team sport, scoring the first goal and the formed psychological moment has much bigger effect for the final result, because by that a positive mindset develops in the first scoring team, which makes the win more likely. [12]

Fans are also involved in living the positive moment. What's more, they play a big role in creating superiority of the home team. Barry Schwartz and Stephen Barsky called the home fan base social power and notes as the most important factor in the existence of the home lead. [13] The supporting or not supporting competition condition, which are formed by fan bases, thy greatly influence the performance of teams. Chris Goumas investigates the impact of the home fan base on referee's decision making in a new related study. In the statistical analysis he investigates matches in the english and german first leagues, during which he found strong and positive correlation between the partiality of the referee to the home players and the size of the home fan base. The larger the home fan base, the more observable the partiality of the referee, by number, if the stadium is half filled, then the visitor team is gonna get more yellow cards by 13% and if the stadium is almost fulfilled this number goes up to 35%. By these results it's clear, that with the support of the home team and a massive headcount in the stands contributes to the preference of playing in home.[14]

The studies discussed here are just a slice from the literature of the research about the effects of the home pitch. The articles, complement with each other, confirms the advantage of the home playing team in football, since they investigates the same question in many ways, that which other factors are affects the development of the game. Although to the best of my knowledge, no study has been made about the large-scale matches yet, as well as the attachment to the advantages of the home pitch, the factors and statistical results defined above are serve as a solid research base.

Questions, Hypotheses

The purpose of my research is to explore the incidence of large-scale victories based on statistical researches. With the avilable database, i'm going to investigate the data of five different european country's leagues projected back 23 years (1995-2018), analysing them by leagues and comparing them with each other to get answer to my questions below.

My first hypothesis is focusing on the advantages of the home pitch, according to: (H1) Large-scale wins are more likely to occur in home pitch. As I said before, numerous literature concentrates ont he positive and negative impacts on the players of the home environment, examine them from different perspectives. With my first hypothesis, I go around the same issue, leading up that the home playing teams are more likely to win with 4 or more goal diferrence.

My second and third hypothesis are dissect further the conditions of the formation of large-scale wins, but this time focusing on temporal factor and it's impact on the teams and players. According tot he second: (H2) High-winning teams are already take the lead in the first half. I'll

examine each match to verify the assumption to find out, that in matches ending with a large difference, also known as ’rich in goal’ , when the outcome of the match is decided, when the winning team gains superiority.

According to the third hypothesis: (H3) The high difference wins are specific in the first section of the leagues, it’s compare the leagues by terms of the occurence of these matches. I suppose that winnings with high goal differences are related to the mental and physical freshness of the players, which help to avoid the accidents, injuries easier, the practiced tactics are live even sharper in the memories and the stamina is better too. Together they’re thought to a have a positive effect for a higher incidence of high goal difference wins of the better teams in the first section of the leagues.

Research methodology

a. Data

The data on which my research is based, I obtained it from the comparison and merging of two databases. While one contains the halftime standings, but every match is take part in twice, so the other controll database not cotains the halftimes, but in return only the actual match location can be found in it, so it contains the essential data for the research, who played at home. From the comparison of these two databases, I created my final database, which is the basis of the research. I found the data on the site of a company called Kaggle, which is a subsidiary of Google, an online community, where researtchers can publish their data sets. [15] The two data table serves together the basis of my further invastigations and my findings

It contains detailed informations of the football matches played between 1995 and 2018, which are played in the top five leagues ranked by UEFA, so the english Premier League, the french Ligue Un, the german Bundesliga the spanish Primera Division and the italian Seria A. Our database contains: the league’s name, the full time of the match, the season, the year, the name of the home team and the visitor team, in which round they played the match, goals scored by each teams and the goals scored before halftime by each teams.

b. Methodology

My research is based on the analysis and comparison pf different leagues. I considered matches that ended with a difference of four or more goals to be a big diferrence. From the databases mentioned above, which contains the data of all the matches played between 1995 and 2018, I only focused on matches with four or more goal diferrences. So I got the set of 2099 match items, which

serves as the basis for the research. To answear the research questions using the database, I made different statistical calculations and with using functions, I continued to filter and grouped the data. The statistical analyses were performed in the excel program of microsoft.

I formulated four main questions at the beginning of the research that form the basis of the methodology. When it's typical to be a large-scale superiority in matches in the first or the second half)? In which rounds of the leagues the high goal difference wins are typical? In which of these examined five leagues is the most and least typical the incidence of these large-scale matches? The home or the visitor teams are more typical to a large-scale victory?

The first and second question focuses on the temporal element, but while the first examines each match according to the halftime data, until then the other compares the leagues and the basis for this comparison is given by the frequency of matches with big goal differences per round. The third question takes the distribution of the number of items per leagues as a source and the leagues are comperable by the results of this. The starting point of the fourth and final research question defining the methodology is again the total number of items but here I'm looking at the outcome of the match for the winning team. The home or visitor identity of the winning team was not included in any of the used databases, so I had to create the column containing data with the help of functions.

Results, analysis

Statistical measurements performed on the data set detailed above, produced the following results. The Board 1. includes primary filters and summaries. We can see the data of 2029 matches in it, broken down into the five european leagues (Primera Division, Premier League, Bundesliga, Ligue Un, Serie A) featuring 195 different teams. Altogether they scored 10225 goals in these matches, as a result, on 2029 occasions, the home team won 1500 times. The difference between each leagues can also be observed on the basis of the data in the table, both in terms of the ratio of the number of matches ending with a big goal difference and in terms of the sum of the number of goals scored. Despite the spectacular differences, the average goal difference per big goal difference matches was almost the same, between the winner and the loser team was 4,46.

Table 1.: Leagues

League	Number of matches	Home	Away	Number of goals	Average goal difference
Primera Division	542	409	133	2796	4,48
Premier League	488	350	138	2459	4,46
Bundesliga	417	307	110	2143	4,44
Ligue Un	311	238	73	1521	4,4
Serie A	271	196	75	1336	4,36
Altogether	2029	1500	529	10255	4,46

a. Advantage of the home pitch

The first hypothesis of the research, according to which there are several times a big difference victory ends in favor of the team which playing at home, can be clearly substantiated by the studies. **The result shows that in 74%, the teams can win with 4 or more goals, which are playing at home.**

This phenomenon is explained by several factors listed in detail in the literature review. The home team doesn't have to travel to an away venue, which travels are often means a mental and physical tiredness for the players. [13] The domestic environment and the usual stimuli are also an advantage in terms of the implementation of tactical elements. It's not a coincidence they have the expression '12th player' for the domestic audiance, whereas according to some observations the sound and the encouragement of the crowd is mentally spins up the home players and also affects their physical performance. In addition, the presence of a fan base can influance the referee's decisions, as more likely to judge doubtful situations in favor of the home team, if a large number of home fans are present. [14]

As nearly the two-third of the matches contained in the database were won by the home team, so the arguments above, beside the advantage of the home pitch and by that these successfully goal-rich games are expands the investigations so far around the curiosities of the home track, with another feature.

b. Halftime distribution

The hypothesis, according to which the large-scale wins are even develops before the halftime, at same time, based on the advantage of the home pitch and the factors involved in it, which are exists even before the match. Such factors may be present among others, the deficit of the best player or players, overload and the priority between each cup series. Therefore it can be said, that even before the kick-off may occur, that some players of the team are in a mental and physical disadvantage (presumably for two teams of equal ability) **The analysis showed, that 52,75% of the large-scale wins are develops even in the first half.**

After scoring the first goal, the leader team got the mental advantage, for this reason the opponent team may become more prone to haste, to implement inappropriate technical solutions, occasionally, conflicts within a team can also develop (Lago-Plenas). Previous reserches has shown, that in the elite football, scoring the first goal is predicts the end of the match, since in 70-75% that team would be the winner. [16]

Although this result is just over half the number of cases, however, together with the following data, a very imporrtant feature is described about the high goal difference matces in football.

c. Advantage of the first half lead

I found during the study, that in 91,4% the team which is leading in the first half, will win the match with high goal difference. This data is an important and significant result of the study. As i've illustrated earlier in the literature review, several authors deal with the positive and negative effecs of psychological moment in the life of sport. Since football is a low score ball game, therefore scoring the first goal and the halftime advantage is going to make a positive psychological moment, which develops a perception of the game, which makes the final win more possible (Lago-Penas).

In case of the matches with a large goal difference, this high number may also indicate this, because the team with the disadvantage in addition to experiencing a negative experience, it's often forced to change its line-up or in the composition of the players on the field. They have to play in a more offensive way, which loosens their defenses, so areas can open up for the players of the team with lead and better ability in many cases, which may result in more scoring chances. So the team that took the lead anyway, can enrich the number of goals they scored.

d. Average goal difference

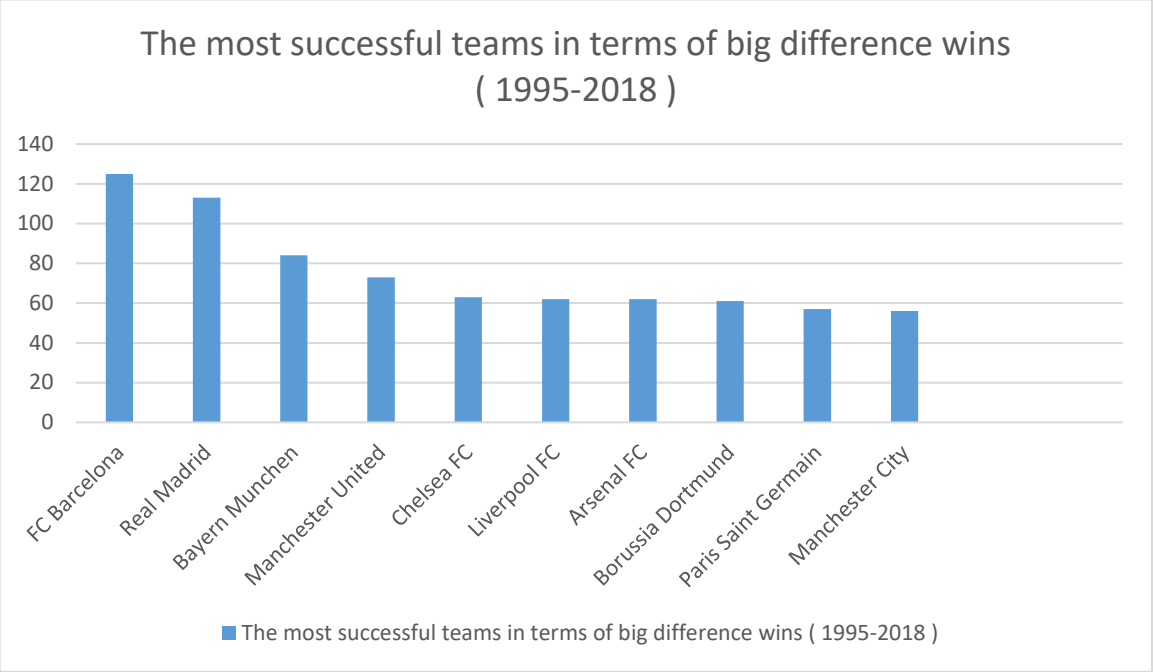
In Board 1. it's well observable, that although the number of large-scale matches is split between leagues, **there is no significant difference in the average goal differences, the average goal difference for the winning teams is 4,46.**

This is explained by the fact that if a team leads by four goals, many times during the rest of the game they will no longer be motivated to score more goals, aware of the almost certain victory. In addition, in the event of a big difference, the coaches replace the dominant players on their team, the **underlying** intent of this may be, among other things, that to rest their team's best players or even to give chance to the young, emerging talents. For any cases that arise may result in structural changes in the team's line-up. If the starting eleven is changed, the harmony of the team will also change, which may result in no more goals being scored.

e. Distribution per round

When comparing the leagues by years, I found that except for the last four rounds, the number of **matches** was split in equal numbers. Only the last four rounds are an exception, where the number of examined matches was negligible. So it can be said **that a big goal difference win can have the same chance in any rounds of the leagues, except the last four rounds for which the probability is 0,04%.**

Before the start of the seasons, the teams participating in the league usually start preparing at about the same time, the players have similar number of trainings, training matches in their legs with which they starts the season. Therefore, the teams in the first round of the season starts with almost the same physical and **mental** preparation. So here the results are determined by the actual form and the strength of the teams. We can trace back to a number of factors, that in case of the examined leagues, the large-scale winnings are the least likely in the last four rounds. Due to its high frequency it can be stated that the outcome of the leagues are decided even before teh last four games, for those teams, who aren't in a race for the title or they cannot longer go forward or backward. Another reason could be the tiredness at the end of the season, as a result of which the players no longer can mobilize their reserves and a result of that no longer develops large-scale winnings.



1. Graph: The most successful teams in terms of big difference wins

f. Comparing leagues

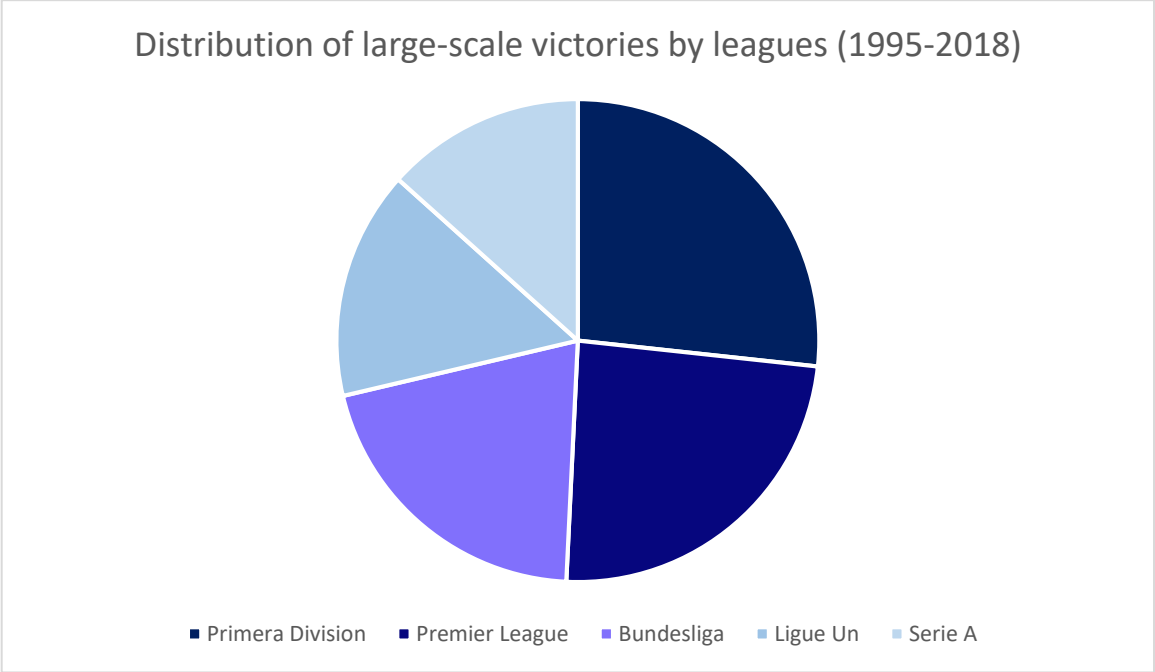
As the last result of my research, I found that the big goal difference matches among the five examined leagues, are the most likely to happen in the spanish league and the least likely in the italian league. This result supports the statement, that every country has different football culture, which defines the characteristics of it and by that it can directly affect the development of the matches and the final results. [17]

The spanish league is considered the strongest and the best. For this reason, the players listed here typically stands out with their abilities and technical knowledge. Their game is based on offensive perception and technical goal-scoring play with short passes. The spanish style of play called Tiki-Taka features that the players without the ball ara always in the move, their purpose is to make new ways for passes and to close to opponent's defenders or their distraction. [18] These style marks can cause the result of many large-scale victories.

In contrast, the italian football, which is called Catenaccio. It's based on an organized, disciplined defense, which are given a lot of emphasis during the game. The primary purpose of the style is to neutralize the opponent's attacking game at the maximum. Usually the team that takes the lead is settle into a counter attacking style of play. After getting the ball, the goal is to build an attack as fast as possible. [19] In the english league, which has the second largest number of large-scale

wins, the most characteristic style of play is the long-ball game, which used to get the ball behind the oppoonent's defense line so quickly. The german league is characterized by organization and precision, which are results an effective but less spectacular football, while in the french league, there are fast passing and attacking, but at the same time, a great emphasis on the defense. [20]

These finding also show, why the italian league's matches are end with fewer goals, so why the frequency is lower of the matches with four or more goals in the Serie A, as in the other leagues.



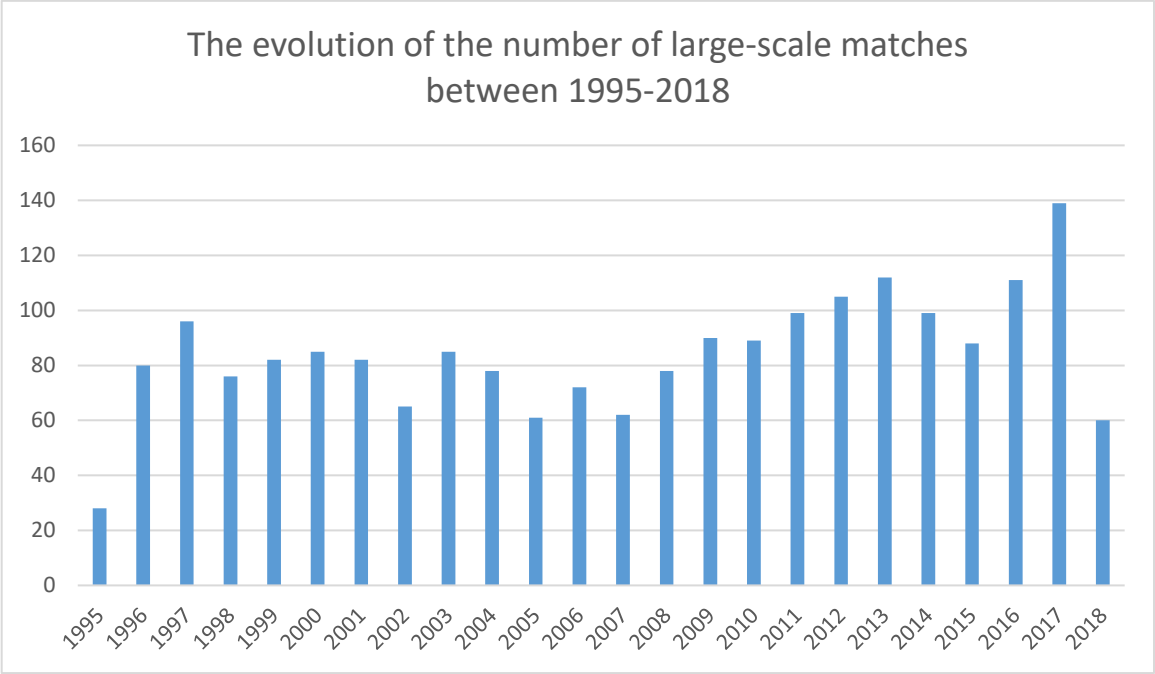
2. Graph: Distribution of large-scale victories by leagues

g. Annual distribution

The last aspect of the research, based of which I analyse the results, is the change of the number of large-scale wins over the years. It can be well seen in the figure below, that the relative distribution is nearly the same, a large outburst is occured only occasionally. With this filtration, I checked the effects of globalization on football, if there has been a so-colled gap between the leagues and their best and worst teams, thereby increasing the number of matches with big goal difference.

In Europe, football is ruled by a a relatively small elite, which clubs are able to play in a higher level constantly, then the other teams. Under the football globalozation, I understood this phenomenon and that in Europe, the richest clubs are dominate the market, they attracts the talent to themselves, so the wins and profits are monopolized by this, so the differences and gaps will be more

and more bigger between clubs. These clubs are not just exproprites the chances of winning in each league, but thereby they limit the competition as well as the range of participant in the competition. [21]



3. Graph: The evolution of the number of large-scale matches between 1995-2018

However, it can be **said by the recent research, that it isn't a clearly demonstrable effect of the globalization development on the big goal difference matches.** No drastic increase was observed, in the five league during the examined period about the possible development gap, which can be admitted to the globalization effect between the clubs.

Reesearch summary, conclusions

Based on the research results, we can say that in the highest ranked leagues by the UEFA, typically the home team achives large-scale victories, the home pitch is definitely an advantage for the home team. 74% of the large-scale matches finished in favor of the home team. In 52,75% of these games, the winner team was able to get advantage even before haltime.

However it can also be stated, that in these matches the finel goal difference is 4,46, which is not with much, only more with a half goal as in the conceptual definition. Bigger difference only developed in rare cases in the examined database. Based on my observations, the high difference matches can develop in any rounds of the leagues by the same chance, so the players' mental and

physical status isn't affect it. The last four rounds are the exceptions, because it's remarkably small in these matches compared to the other rounds. (0,04%)

In the majority of cases, those teams firm the decisive superiority of 4 or more goals, which scored the first goal of the match. 91,4% of these cases is realized so in the terms of the evolvation of the result, it's a decisive factor, that which team scores the first goal. Finally, based on my research these results are most likely to happen in the spanish league and least likely in the italian league. These results are affected by the football culture and game phylosophy of each country. It follows, that the spanish offensive and technical game is result more goals and more big difference wins, than the tactical and defensive italian football.

The foreign location for the away team is a disadvantage even before the start of the game. It my be worth moderating these disadvantages by psychological preparation or travel to the location 1-2 days before the match. This would allow the teams to potentially moderate the negative effects of the travel. In addition, it can help the coaches of how it's worth to change the team by the actual results.

At the same time, the research can form a good starting point of the following researches. A research theme like the example mentioned before, that the away teams how can moderate their disadvantage, which caused by the foreign location. Another possible research direction can be the evolution of the today developed Covid-19 epidemic situation and the large-scale matches. Since its explosion, much of the teams are forced to play their matches in empty stadiums. By examining the results of these matches, especially focusing on the large-scale wins, interesting conclusions and observations could be done, among other things that how the deficit of the supporters can affect the result of the match and the number of goals.[22]

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IoT architecture 2

Péter Török
National University of Public Service, Hungary

Abstract

Today, Internet of Things (IoT) is becoming more and more a part of our lives. It also surrounds our homes, our transportation, our healthcare, and our industry.

The wide range of IoT sensors used in the systems provides a huge amount of data. This data is then shared on the network with other devices as well as different applications and infrastructures. Countless new IoT-based applications have been developed day by day. This also increases the possibility of using it. . In this publication, I present the current architectures.

Keywords: Internet of Things; machine to machine; architecture

Introduction

The IoT paradigm refers to a system of devices that are interconnected, equipped with computing capacity, identifiable, and allow data to be transmitted over a network without the necessary human interaction. This concept is based on the proliferation of smart devices that work together to achieve common results.

In addition to any new technological trend, there are three possible categories of challenges facing the IoT: business, society, and technology. The challenges in the business area are primarily to identify the motivation to start investing in a particular product or not, and to develop a business model to achieve economic benefits. In this category, depending on the use and the type of customer, the products can be divided into three categories:

- Internet of things for consumers;
- Commercial Internet;
- Industrial items online.

In society, the challenge is to identify with the perspective of the customer who benefits from a product. This requires consideration of some elements, such as the ever-changing requirements and needs of the customer, the emergence of new tools, customer confidence in certain brands and products, and a lack of knowledge of best practices in privacy and security.

IoT requires minimal components to integrate into everyday objects. The miniaturization and integration of the components themselves is an area that can be expanded by integrating the silicon components with metallic or fabric materials. In addition, such components are needed to quickly collect the required energy from their environment and use it profitably. Smart objects must withstand harsh conditions, be it humidity, temperature, shock, or vibration; for their daily use, they must be extremely reliable and guarantee very high and constant quality. Another aspect that is often underestimated is the ability of smart devices to self-configure and organize. In addition, you will need to find standard protocols to uniquely identify objects. Moreover, a critical field deals with security to find solutions for the security of connected objects, preventing cyber attacks that could undermine the global growth of the Internet of Things [1,97-98].

The most common IoT architectures

To advance the deployment of IoT systems, one of the main challenges in managing the technology space is to define a reference architecture that supports current services and future expansions. Therefore, such an architecture should be [2,55-75]:

- scalable;

- interoperable;
- easy to implement;
- power saving;
- safe.

I have already shown in my previous publication that there is currently no universally accepted reference architecture [3,13]. Despite many standardization efforts, it is very difficult to accept such an effort. The main problem lies in the natural fragmentation of potential applications, each of which depends on very different variables and design specifications. To this problem must be added the willingness of individual manufacturers to recommend their platform for similar applications. Figure 1 shows the most commonly used IoT architecture.

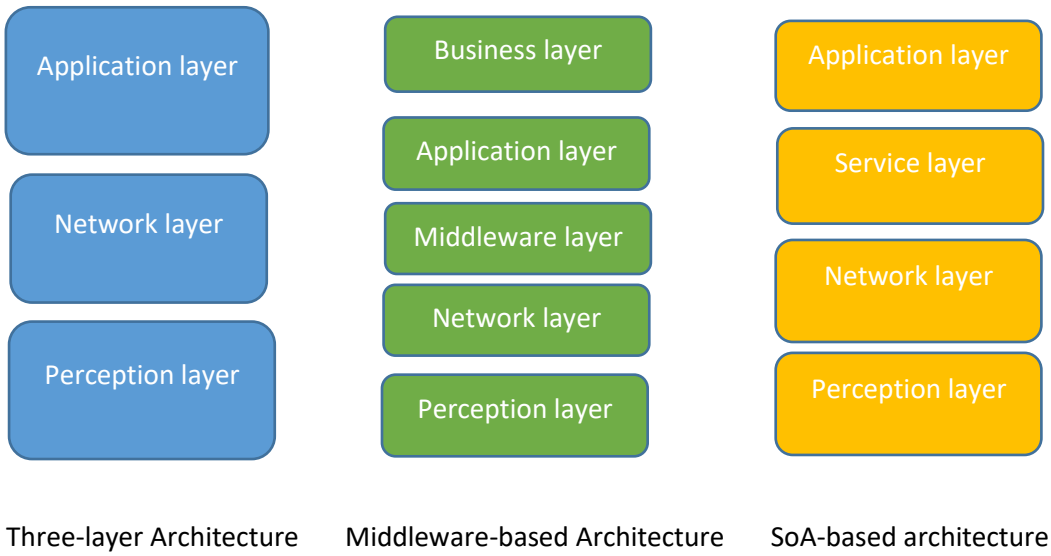

Figure 1. Most common IoT architectures (Created by the author)

Three-Level Architecture

A three-tier, general, high-level architecture has been introduced in the literature [4,17]:

- Perception;
- Network;
- Application.

Perception Layer

The perception layer represents the physical level of objects and interacts with the surrounding environment by collecting and processing information. This level includes the subject of interacting with the outside world and equipping IT capabilities in a sense of intelligence or ‘intelligence’, where intelligent is based on technological aspects and intelligent functional aspects of sensor.

These intelligent objects, which are the basis of the basic blocks of IoT, can be objects of general use or simple devices with sensors and computing capabilities. Smart objects are usually equipped with the following basic properties [5,35]:

- Communication;
- Identification.

Depending on the application, one or more of the following properties may be added [6,243]:

- Addressability;
- Sensing and operation;
- Embedded information processing;
- Localization;
- User interface.

Network Layer

The function of the network layer is to transport the data provided by the detection level to the application layer. It includes all the technologies and protocols that allow this connection and should not be confused with the network layer of the ISO / OSI model, which transmits data only on the best route within the network.

A large number of protocols can be used in IoT. Each has advantages and disadvantages, and use should be evaluated according to the application. For example, the IPv6 protocol was first born to solve the problem of addressing space and then to ensure the scalability of systems. However, this protocol is designed for wired networks. The 6LoWPAN protocol has been developed to comply with wireless sensor networks (WSNs). WSN is infectively composed of devices that are characterized by low computing power and that often minimize power consumption. This way, devices can look directly at the network without the need for other devices to act as a gateway. However, such gateways may be required in certain applications. In these cases, it is possible to use data link layer protocols such as Bluetooth or ZigBee to connect gateways and sensors, and then connect the gateway to the network only with the network layer of the IPv6 protocol.

Wireless protocols are particularly important in this layer. Compared to the required cables, wireless sensors can be installed in hard-to-reach environments and require less material and human resources to install. In addition, in a wireless sensor network, different nodes can be easily added or removed and relocated without rethinking the structure of the entire network. The choice of protocol used depends on the size of the network, the power consumption of each node, and the transmission speed required in a given application [7,142].

However, other applications may require a wired network. The latter has higher reliability and higher transmission speeds. An example is the internal network of a vehicle, which connects the various electronic control units (ECUs) that control the mechanical parts of the car. In this case, a reliable and fast network is essential, as delays or failures can have serious consequences.

Application Layer

The application layer includes all the software required to offer a particular service. At this level, data from previous levels and databases, analysis software, etc. are stored, aggregated, filtered, and processed. As a result of this processing process, the data becomes available to real IoT applications. This is often done using certain software, defined as middleware that is responsible for hiding the heterogeneity of the underlying layers. Some software technologies that are currently widely used to handle the huge amount of data provided by devices include:

- Cloud computing;
- Edge computing.

This level also includes handling the format of the data to be processed. These types can be [8,144]:

- binary based, small in size but not human readable;
- text, larger in size but human readable.

I have also mentioned some of the many commercial platforms used to implement IoT applications in the previous section. These include Amazon AWS, Microsoft Azure, Firefox WebThings Gateway, and more.

Middleware Architecture

Another important and very common architecture of IoT is middleware-based IoTarchitecture or five-tier architecture [8,4]. In recent years, the proposed architecture of IoT needs to address a number of factors such as scalability, interoperability, reliability, QoS, and so on. In this regard, middleware-based IoT architectures help create applications more efficiently; this layer acts as a connection between applications, data, and users. In fact, the development of IoT depends on the development of technology and the design of various new applications and business models. To allow for this and many other features, a five-tier architecture has been proposed, consisting of five levels: perception layer, network layer, middleware layer, application layer, and business layer. In particular, the intermediate layer has some critical functions, such as aggregating and filtering the received data from the hardware devices, providing information discovery and access control to the devices for the applications. Typically, middleware is the programming of software or services that can provide an

abstraction. Between IoT technologies and applications. In middleware, details of different technologies are hidden, and standard interfaces become available to developers to focus on application development without considering application and infrastructure compatibility. Middleware has become increasingly important in recent years as it plays an important role in simplifying the development of new services and integrating old technologies into new ones. This excludes the programmer from an accurate knowledge of the diverse technologies used by the lower layers. Advantages [8,36]:

1. Support for various applications;
2. Runs on different operating systems and platforms;
3. Distributed computing and the interaction of services between heterogeneous networks, devices and applications;
4. Support standard protocols;
5. Provides standard interfaces, providing portability and standard protocols to allow interoperability, and the important role of middleware in standardization;
6. Provides a stable, high-level interface for applications.

Service-Oriented Based Architecture

The last architecture just presented is the service-oriented architecture. In general, service-oriented architecture (SoA) is a component model-based structure that can be designed to connect different functional units of applications using interfaces and protocols [10,10]. The purpose of SoA is to coordinate services and enable the reuse of software, hardware components. SoA can be easily integrated into the IoT architecture, extending the three-tier architecture by adding a new layer between the network layer and the application layer, the so-called service layer, which provides services that support the application layer. These four layers represent a SoA-based IoT architecture that includes the detection layer, the network layer, the service layer, and finally the application layer. Here is a new layer that integrates SoA functions and differs from the architecture described earlier. The service layer consists of service discovery, service composition, service management, and service interfaces. Service discovery is used to explore service needs; the composition of the service is used to interact with the linked objects and integrates the services to achieve requests efficiently; service management is used to manage and define ordering mechanisms to understand service requests; Service interfaces are used to support interactions between all services provided [11,38].

Conclusions

This article provides an overview of the architectures, technologies, protocols, and applications that characterize the IoT paradigm. In particular, the thematic architectures used in the

IoT domain have been described based on their reference layers. Key application areas such as Big Data, Cloud Computing, healthcare, smart city, smart home, smart grid, mobile applications, cyber industry, smart agriculture and automotive have been identified.

The reference architectures presented are similar in their concept, but also differ in technology approach and implementation. Therefore, it would be difficult to draw a strict parallel along the definition of the IoT architecture and the TCP/IP model. Given the huge variety of IoT networks, we can best hope for the future. They will be compatible along some common elements or principles.

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