Igor DJUROVIĆ*

IMPACT OF ARTIFICIAL INTELLIGENCE TO SOCIETY

Abstract: We are facing deep symbiosis between humans and technological gadgets. It seems sometimes that students 80% of free time spend by looking at mobile phones, tablets and laptops. Often the same can be observed for example with participants of meetings and conferences, even pedestrians, persons in restaurants, car drivers, etc. On the other hand there are fears about technological progress and its impact to humans. These fears are not something novel and they can be traced for hundredths of years and they are often rational. In this paper we are considering expected impact of the artificial intelligence to human society in future through four fields: job market, overall economy perspectives, war/defence industry and humanism of society.

I. INTRODUCTION

Transition of society in England during industrial revolution caused huge movement of rural workers toward cities [1]. It was one of biggest migration in history with respect to percentage of population followed by huge suffering: starving former agricultural workers, very low wages of unskillful workers, rise of crime etc. By some accounts at least 1 million persons suffered heavily in transition from agricultural toward industrial society (more than 12% of population). It motivated the Luddite movement called by Ned Ludd who smashed two stocking frames in 1779 [2]. Such anti-machine movement lasted for about 3 decades and it was suppressed even by army intervention. Historians claim that it was uprising of unskillful workers while skillful workers, artisans and creative persons only benefited from technology. However, there is a question was it possible for huge rural population to adjust and acquire new knowledge and skills in short time. Also,

* Montenegrin Academy of Sciences and Arts; University of Montenegro, Faculty of Electrical Engineering.

it can be argued that increasing number of skillful workers would cause increase of wages and reduction of profit in industry meaning that large workforce of young (often kids) unskillful workers was beneficial for owners of machines and capital.

There were also many unreasonable fears related to technology. Today it is funny to mention that in some of US states it was law to put disclaimer on public places close to electrical light switch like: "usage of electrical lights is on your own responsibility" [3].

History of human-to-technology interaction is rather complicated and it seems like the Stockholm syndrome: we fear from it but in the same time we are in love and we are dependent on technology. During course of time both emotions in this relationship grew. Such process is not only due to non-rational individual and public opinion but also from habit of industry and inappropriate practices coming from scientific, industrial and technological circles [4]:

Pollution, usage of unsafe materials and practices, have been quite often covered by scientific studies coming from "reliable" universities and research centers;

Usage of additives in food, different agricultural practice, unhealthy products in pharmaceuticals, food, beverages, tobacco etc.;

Usage of unsafe materials in construction, energy projects having huge negative impact to society, huge impact to available drinking water for example by agricultural development etc.

Almost all above mentioned developments were defended by governments/politicians/industry but unfortunately often by academic sector.

Situation in current public discussions is on the edge with numerous conspiracy theorists earning livelihood by popularization of different silly theories all the time causing that public debate on many issues is impossible. For example in Montenegro it is very difficult to open public discussion about usage of Tara rivers for big energy projects due to, in my opinion, wrong presumption about impact of planed plants to Tara river canyon. Unfortunately, due to previous and ongoing errors and wrongdoings it is not strange that such resistance exist in public.

This paper is organized as follows. Brief review of the main current development in the information technology area, i. e, artificial intelligence, is discussed in Section II. Impact of the artificial intelligence to four aspects (job market, overall economy development, war/defense industry, and social aspects) of the human life is considered in Sections III–VI. Some conclusions are given in Section VII.

II. ARTIFICIAL INTELLIGENCE REVOLUTION

After first industrial revolution we are in age of information revolution. It seems that information revolution is in early stage of huge acceleration. The term of artificial intelligence becoming one of the most frequently used in media but also in science in last 10–20 years and usage of this term is growing day by day [5], [6].

What is artificial intelligence? To be very honest I do not know. In fact there is no short definition easy to present and understand. First we know that it is set of computer algorithms and methods. But what are the crucial features of the artificial intelligence?

Let us consider one simple problem. Car is going on road equipped with camera. There are no other vehicles on the road, or pedestrians, or obstacles, etc. There are white lines on both side of the road. The goal of the automatic driving system is to pass the road going between two white lines. System is simple. In the case that camera records that car is too close to one of white lines, it will issue feedback to control unit to move car from that line. However, situation is not so simple since we do not want to make sudden changes and turns that can endanger car and persons inside. In the case that car is stable on 30cm from line system order could be to move slowly from the line without sharp turns, in the case that previous measurements were 15cm, 20cm, it means that car is going away from the line and order could be not to do anything while in the case that previous measurements were 60cm, 40cm, order could be sharp turn in other direction in order to avoid impact. We can conclude that such system requires some historical measurements called samples or nodes. These nodes are not equally important and the most recent are more important than previous ones and they are taken with larger weights. Optimal set of weights depends on many factors like for example velocity, visibility, etc. So some adaptation of weights is required. It is done based on a relatively simple and clear criterion. Such systems are called adaptive and they are in development for more than 60 years with numerous extensions. It is estimate that hundredth of thousands (if no millions) of papers are inspired with such development called with various names: adaptive system, linear weighted adaptive adder, optimal systems, Kalman filter/predictor/estimator etc [7]. One of the core elements of the system is gradient adaptation of weights: we are starting with some initial values of weights and gradually, based on introduced criterion or criteria, we are approaching toward better or optimal weight values. However, nobody considers these systems as part of the artificial intelligence framework.

Now we are coming to question (and part of answer) what is software or method to be called or assumed as artificial intelligence? Firstly, it should be complicated, more complicated than the linear adaptive weighted adder. Also, it should work with more data, more inputs and outputs. Optimization criterion is often not well defined but fuzzy. Finally, it should mimic biological system, i. e, way of work of humans or at least animals. This is the reason for many algorithm types called in analogy with bio-inspired systems: neural networks, genetic algorithms, evolutionary computation, ant colony optimization, etc [8–10]. From all mentioned prerequisites that some method is part of the artificial intelligence toolbox this seems the weakest. According to current knowledge about intelligence in biological systems there is weak correlation between a way how such systems work and a way how scientists, mainly in computer science field, gathered inspiration for development of their methods [11].

The term artificial intelligence has been coined more than 150 years ago [12]. Many paradigms have been developed in the first 50–70 years but without significant technical developments. In fact nowadays we can considered that this phase is more philosophy with relatively small number of useful developments (it was concentrated to terms like cybernetics, definition of formal languages, expert systems, etc. but nowadays relatively small amount of useful methods come from this period). An excellent historical overview of the artificial intelligence development can be found in [13]. In addition to excellent historical overview in intro chapters we can find similar reviews about some of topics or tools covered.

Before presenting details about current development in this field some insights about popularity of the artificial intelligence field nowadays are given. For persons working in related fields it is not new. Also, for general public following media and popular culture it is not surprise but I will tell you some info from universities and research community just to illustrate the issue. Some basic courses in this field are selected by more than 500 students at one of major engineering schools in the US last year. In the same time one of the fundamental PhD course in area of communications (Digital Communications) at the same university has been cancelled for first time in 30 years since it is selected by less than 3 students! ? C olleagues teaching Signals and Systems are summed up and asked to change course to embed some artificial intelligence concepts since it is also in danger to be cancelled due to small number of attendees. Number of published papers in some of the artificial intelligence fields growing rapidly. Only on topic related to deep neural networks it is published more than 50.000 papers in the

last 12 months in referred journals and conferences [14]. This is also clearly reflecting funding for this topic and number of related projects.

One of developments or tools that I will mention within this talk in the artificial intelligence field is neural networks. It was developed almost 75 years ago as concept of some system that should mimic human brain and nerve system [15]. Off course even today we are far from anything that can be considered as close replica of the natural intelligence of biological neuron networks. It took more than 30 years that the first network is actually developed and next more than 15 years to develop multi-layer architecture of neural network and that this research becomes mainstream (somewhere early in 1990-ties). What is basic idea behind neural networks? For example we are developing tool to read characters, recognize cars or vessels, some problems in recordings of human tissues, etc. Obviously such objects have many characteristics it means that system would have many inputs (nodes). Also, these nodes are not of equal importance. It means that they will be taken with different weights. It is called input layer of a system. At the end of the system we are making decisions or decision by gathering results of different paths in processing. It means that system has output layer with several nodes. Since we do not need some number at the output but decision about car type, plate number, or character than at the output we have nonlinear element making decision if some number is above threshold decision is positive and otherwise negative. In fact neural network is not so simple. In order to achieve practically any results we have to add additional number of nodes in layer between input and output layers. It is called hidden layer. Therefore, in system we have three layers with several, tens or more nodes and weights in all connections between them. Then, we can have hundredths, thousands, or tens of thousands weights to be determined.

Determination of weights is performed in (machine) learning phase. The system is fed with many test examples and weights are determined (system trained) to achieve minimal percentage of miss trials. System begins with weights determined in learning/training phase. Over course of time based on some additional criterion (for example pleasure score of users) it can additionally to adjust weights.

The neural networks gained huge popularity in 1990-ties up to 2000. This popularity is in fact just pale comparing current artificial intelligence hype. They achieve excellent results for some tasks. Many groups working on the neural networks appeared as mushrooms in the rain [16]. But as it is usual unrealistic promises and expectations probably issued to attract investments and projects caused reverse of tide and investments dried up and groups working in the field rapidly disappeared. In early 2000ies the

Canadian institute for advanced research group was almost unique larger group that continued neural networks research with decent funding, and large number of highly qualified researchers [17].

But sometime in 2006, 2007, 2008, gradually novel term emerges in the field that caused current havoc. It is term of deep learning [13,18]. It is covered with tens of thousands paper in world journal nowadays and it is the main trendsetter and benchmark setter. What is difference between standard "shallow" learning and deep learning for example related to neural networks? It is in fact in number of middle — hidden layers. We are now using more and more layers between input and output. Recall that increase of number of layers heavily increases number of nodes in the system but what is more critical number of connections (weighted) increases exponentially! It can be now millions or tens of millions of connections in deep network nowadays or to say 3 or more orders of magnitude than in standard neural networks! In fact, it is worth to note that first neural network architecture proposed in history was deep but it is not implemented due to calculation complexity!

How we are now able to calculate in the training/learning phase and how we are able to update weights by recalculation latter on? The first obvious answer could be that we have now faster computing machines but for everybody working on complexity of systems and algorithms it is known that exponential increase of complexity is not something that can be easily overcome only by increase of computing capabilities. In fact the secret is the novel stochastic gradient algorithm for weight estimation/optimization — calculation [19]. Just remember that gradient algorithms are used in the weighted linear adders mentioned earlier but novel upgrade allows evaluation of weights several orders of magnitude faster than in the standard algorithm. In fact such development is source of current progress in the deep learning.

Just for illustration about current progress to give single illustration. My colleague working at one of Middle East universities for course of machine learning has issued project to student related to recognition of some object in satellite images. Up to 2016/17 such projects required about two months to be completed (one month only for training phase). However, in season 2017/18 a student downloaded training sets, some free available software library for deep learning, started training and during three hour lecture obtained results were more precise than benchmark results from the previous years with immediate impact that fellow professor had to change and find more challenging problem.

Similar reports are available everywhere. Persons with very small knowledge on some subject with free available software can obtain results in

different fields that are outperforming state of the art results. Some researchers argue that it is endangering their jobs. When we are coming to jobs it is going to have to look back at the Luddite movement. Now even some Nobel prize laureates or highly respectable scientists, owner of main ICT companies, technological gurus etc are calling that in order that our society survive it is important to limit development in the artificial intelligence area [20].

Then, we are coming to question about body responsible to establish ban on the artificial intelligence development. Probably it could be governments of world countries signing some sort of treaty. However, immediately we have stop with such illusions. The artificial intelligence research is cheap, it is not requiring huge industrial complexes nor huge energy resources, at some level it does not require too smart individuals, and lot of money. It can be financed by already mentioned 200 governments (or some of them), companies (many of them more powerful and influential than majority of countries) and even by organized crime! Therefore there is no the slightest chance that such research is going to be stopped! It is simple, relatively cheap and next to impossible to be controlled. Together with ability of processing big data it has potential for huge progress but also it becomes one of the main fear factories nowadays.

Just to illustrate how this research can be relatively cheap it can be noted artificial intelligence related research from UK resulting in interesting and applicable results. The healtex project has used artificial intelligence for text parsing from about 15.000 medical research papers [21]. About half papers were full text and the rest were only abstracts. All papers were related to study of pain under two relevant scenaria. It was looked for body reactions, so called pathways and role of proteins in these pathways with positive (it has role in pathway related to pain) or negative no-impact. After analysis it is discovered that 11 proteins play significant role in studied pain reactions. However, developed pills and treatments are related to only 4 of them. It is increase in potential target for treatment of 175%. About 10 existing freely available software tools were used in study. The longest part of the study was to adjust input of existing software interfaces to text extracted from medical journal papers and machine learning. It lasts 6 months and two experts were engaged. In current project related language we can tell that the most time consuming part of project took only 12 person-months! In similar study 7 researchers for two years digging in only 700 papers resulted in one important result. Therefore, power of the artificial intelligence and related tools is clearly demonstrated but also how it is cheap to conduct

research in this area. Therefore, the artificial intelligence cannot be stopped or controlled by administrative means.

Now I am going to mention four fields of human life where we can expect significant impact of technology and artificial intelligence over years (in fact it can be expected on all human activities): jobs, overall economy, war, and entire humanity. Of course I am bringing more overview of opinions with some comments without final conclusions.

III. IMPACT TO JOB MARKET

It can be expected that number of jobs will disappear due to novel technologies and artificial intelligence. It is almost consensus in open literature [22,23] with single notable alternative opinion presented by World Economic Forum [24]. It is expected that rate of elimination of jobs will be faster than in entire human history with potential for development of new Luddite movement. Novel job creation can be expected but it is almost consensus that replacement rate will be low not replacing jobs that will disappear. Also there is opinion that middle level jobs will be the most endangered while high level are difficult to be replaced (since it is difficult to implement systems that can replace such complicated and sensitive jobs) and low level jobs (it is not cost effective to replace them since these are jobs with low salaries). However, there is growing evidence that this issue is more related to wages than to complexity and job level. For example recent studies [25] about machine replacement of jobs in agriculture in Europe has shown that on line north-west of Europe some jobs are replaced with machines 100% while on south east replacement ratio is 0%. It means that implementation of technology is not so dependent on level of job but on other factors primarily on wages. For example, several years ago we have witnessed walkouts in fast food chain restaurants in the United States due to low wages. The main message was that it is impossible to live decent life with 7.25 dollars per hour. It was significant crisis for fast food industry and lobby group representing their interests launched campaign with advertisements against strikes. In entire page of Wall Street Journal and other newspapers it is published advertisement with photo of Japanese robot allegedly can work the same job (prepare pre-packed food with bread, meat, fries and perform communication with costumers) [26]. However, such advertisement campaign provoked scientists to study lobby and spin-off industry [27]. As we know such jobs are very well paid. And they found based on big data analysis that such campaigns are in fact relatively simple with about 20 basic moves and strategies and in fact that such campaigns can be (even easily) orchestrated by machines in fact by software with artificial intelligence.

Then it seems that high paid intelligent jobs are also in danger. Currently companies like Prophecy Sciences and BambooHR very successively replace human resources departments in companies predicting performance of workers [28,29], even giving more chances to vulnerable categories that the standard and by law supported hiring procedures. Such systems are also used to predict performance of athletes but it is not so important for this talk. The next field I am going to mention is replacement of teachers with software. Couple years ago it was hype in development of massive open online courses attended by tens of thousands [30]. However, distance learning at the moment seems in deep crisis. The main source of crisis are studies proving that attendees of online distance learning courses are significantly behind pupils and students following standard courses (for 4 years of online education loss in knowledge is about 1 year or more an average with respect to those in classical classrooms) [31]. Probably we are underestimating knowledge that students are getting from their classmates through personal exchanges with respect to knowledge gathered from professors. But anyway some distance learning platforms are now more advanced than earlier and they can bridge this gap by allowing different levels of interaction and knowledge gathering. As somebody working in the field of computer programming I have studied some platforms for education in computer programming. One of them attended regularly by about 15.000 persons on university, high school and primary school levels is very advanced [32]. It is concentrated on algorithms, algorithm implementation, algorithm theory, on some level at data structures, complexity of algorithm (both memory and calculation or as it is called time and spatial), interaction with users (including random inputs), testing. Platform is not useful in creating real-life applications with databases and so on. Platform integrates numerous programming languages with different versions. Students for self-education still need some additional material or lectures or to look at the Internet but for university teachers in programming it is almost next to impossible to compete with such platform (of course humans are still behind it but they can serve for tens of thousands students). What to do now? In my opinion only proper mean is to integrate such platforms in education. In fact until it is possible we have to master machines not to break them (as Nikola Tesla claimed). Some "prophecy" claims that the outcome will be undergraduate education run by 10–100 university degree providers and only research related graduate education will be performed in person with advisors etc. Also, surgeon job is one of the most advanced and respectful human activities. But it seems that machine will be able to replace humans in this activity within next 10–20–30–50 years (depending on "prophet") [33]. It seems

that humans will be replaced by tireless robots performing operations on humans with human expert maybe only overlooking activity. Medical diagnostic is area were we have already potential for significant improvement we respect to current state. Medical check-up is lengthy procedure and sometimes proper illness diagnosis is prone to errors and recurrent check-ups and going from one to the other specialists or sub-specialists [34]. This is significant problem for example in rare diseases. There are several important studies demonstrating that illness outbreaks could be detected significantly earlier with such tools, but also situation when environmental risks caused illness could be recognized in significantly faster manner with big data and artificial intelligence analysis of medical records [35]. Only privacy reasons are against such (de-personalized) data availability. Problems in data gathering caused for example that leading USA specialist has the largest database of available records with only hundredths records due to strict data gathering procedures. Some of them are looking for countries without such strict procedures where they can be able to gather more data. Anyway any progress in this area would affect highly paid job market. Therefore we can conclude there are no safe jobs in the future.

Some persons provide that only surviving jobs would be human related activities with preferable personal contact for example hair-dresser [36]. Also sportsmen will remain as part of public attraction since everybody probably likes more to watch football played by humans than by robots. Some expect that only jobs that will survive will be those related to human-to-human interaction. I guess that already we are facing some increase and public promotion of such activities and jobs. Even Jack Ma founder of alibaba enterprise (person with interesting biography but also with very wide business interest going far from online selling of different goods, and person already using artificial intelligence in his business even in agriculture) claims: "we have to change way we are educating kids; within tens of years capabilities of computers would be significantly better than in humans. We should stop to teach knowledge in schools since in knowledge computers will be significantly better than humans. So kids should be taught subjects where humans are unique related to human-to-human interaction, arts etc." It is hard to accept for me since I am teaching knowledge but maybe it is time to think about our educational system from this perspective. To conclude we will see monumental changes in job market but even more we have to think about changes of educational curricula and organization of education. It is rather hard to predict exact direction and scope of changes that will be caused by implementation of technology and artificial intelligence but they will be huge!

IV. IMPACT TO OVERALL ECONOMIC DYNAMICS

About overall economic perspective related to these emerging technologies we can expect and hope that changes will be almost as in previous technological revolutions. Implementation of novel technologies will decrease costs, reduce profit margins, kill many existing businesses, but new products and services will be generated giving more opportunities and further accelerating economy. Not all of analytics believe in this scenario. In fact they (among them former Greek minister of finance Yanis Varoufakis) believe that job market will be depleted with large percentage of persons at the market working for low level jobs (below their educational skills) or underemployed working part time [37]. Also, products of artificial intelligence are very difficult to protect and gain advantage with respect to competition since large portion of this field is related to algorithm development and many open software realizations. Also, if somebody has advantage it will be mainly related to ability to gather huge amount of big data and it will be able to squeeze-out competition from the field establishing de-facto monopoly. Therefore, we hope that transition to this technology, i. e, artificial intelligence revolution would cause standard stressful switching from one (mainly information technology) paradigm to the other artificial intelligence technology paradigm. An alternative is that this transition will be even harder than in the previous technology revolutions bringing some troubles to large percentage of world population.

V. IMPACT TO WAR CONFLICTS

Humans demonstrate huge creativity in war or as euphemistically called defense industry. During entire human history wars are driving force for different technological developments or the main ground for novel technology implementation and testing. There is no doubt that the same holds for artificial intelligence. The artificial intelligence has potential to be applied to various levels of war industry: from planning, command, control, battlefield assessment, to operating level and execution [38]. It is too broad to be covered here and I will limit this discussion only to usage of some technological means directly on battlefield. One of technological developments intensively used in battlefield nowadays are unmanned aerial vehicles — drones [39]. Today there is ability to re-fuel them, some of them have autonomy measured by tens of hours, and even we witnessed suicidal drones performing air surveillance or attacking enemy but at the end it is going like kamikaze to attack enemy or in the case when target is not identified to self-destruction mode [40]. They are popular due to their cost-effectiveness. Such cost-effectiveness cannot be claimed at the moment for autonomous vehicles

robotic tanks and other similar tools used or tested for ground battles [41]. As an interesting point first robo- or tele-tank is developed in former Soviet Union during World War II [42]. Of course we can notice excellent applications like for example automatic mine sweeping devices [43]. Ground drones are not successful with respect to their aerial cousins due to several reasons. They are smaller meaning they are smaller targets as advantage but in the same time they have smaller visibility with respect to standard tanks (and other armored carriers) operated by humans. Also smaller dimensions mean worse cannons and rocket launchers. In addition, in the case of failures tank crew can fix issue or they can be helped by other nearby crews or specialized units for such purpose. It is not case (at least at the moment) with such robotic devices. Operators are not too far from the battlefield currently couple of hundredths of meters or couple of kms, i. e, they are not on safety as it is the case for aerial drones. In urban environment there are difficulties in communications due to buildings, and other obstacles including natural or intentional jamming. To sum up problems some of major powers reporting usage of robotic tanks on the real battlefield have found that they need more humans to be involved than in the standard tank units. However, situation will change within years to come. When we are talking about jamming and intensive electronic countermeasures even aerial drones will face difficulties in coming years. These drones can be launched with predefined program, or most commonly they are operated by humans. In the case of battle with technologically underdeveloped enemy this is no problem but in case of going against enemy that is able to disturb communication it can be significantly more difficult or even impossible. Then we are hearing (currently it is mainly in popular but also in scientific journals and we can expect to be reality soon) about swarming drones, i. e, flocks of drones attacking enemy with limited communication with control unit or without it deciding on their own when and where to attack enemy based on some knowledge but also based on intelligence gathered in surveillance phase [44]. Then we will see possibility that robots killing humans according to their own opinion. This is new twist against already broken Capek/Asimov's robotic laws [45]

1. A robot may not injure a human being or, by failing to act, allow a human being to come to harm.

2. A robot must obey orders given to it by human beings, except where carrying out those orders would break the First Law.

What can go wrong here? In fact here it can go wrong that due to any reason our machine start to kill other persons or even own side. This is in fact one of the most fearsome event in the technology: possibility that machines harm humans directly. Is it possible? We should not underestimate

such possibility especially taking into account that some side in conflict can apply technology under opinion that it is so advanced that enemy has no response on it or under pressure of losing conflict to take some desperate move and to apply unchecked technology. However, in wars there is additional aspect of the artificial intelligence application. In fact we have already claimed that this technology is cheap and it can be used by many countries or even by non-state agents and terrorist to bridge gap to regular armies or other law enforcement agencies. It seems to me that we are already observing such moves [46]. Then, some convention on limitation of the robotic weapons could be helpful but its enforcement is next to impossible. Two main directions in future could be more integrated systems using artificial intelligence, less involvement of generals in decisions, and bridging technological gaps between countries and other entities.

VI. MACHINES AND HUMANITY

Nowadays, the future technological society is predicted based on current observations. Extrapolating our experience leads to the assumption that the future society will have more negative and inhuman characteristics than the present one. Futurologists reached a consensus that the future society will entrust greater impact to machines in everyday human activities. This further increases the anxiety of most futurologists about future trends and symbioses of human society and machines. However, it is question if humans are human? We have already cited usage of advanced big data/artificial intelligence system successively replacing costly human resource departments [47]. These departments are special units in a companies working on the human resources management analyzing CVs, performing testing, interviews etc. The main goal is minimizing risk in the employment process. The process related to reducing workforce is commonly less analytical and more impulsive. The basic features of the employment process are search for: persons with experience, persons with no black spots in career (e. g. without criminal record), persons that have same distinguishing characteristics with respect to other candidates, even if these characteristics are not related to job (e. g. interesting hobby, sport activities, knowledge of some foreign language, etc.) and so on. All these issues are again more related to reducing the risk in employment in order to avoid mistakes and employment of an inadequate person. All other issues related to employment are somehow less important in human-lead employment systems. However, machine based system gain popularity and more than 100 million queries are performed annually only in the USA [48]. These systems process huge amount of data and perform analytics (company, public records, social networks,

CVs, records about response in company etc.). It is cheaper and more precise than existing systems. Also, these systems sometimes provide counterintuitive results with respect to the existing expert-based methodologies, but also these results are significantly better than those of the existing approaches in terms of hired workers' abilities. In addition, some of results provided by these systems are more human than the existing expert based strategies. Firstly, persons with criminal records, or some obvious problems in the employment history, are commonly excluded from considerations for all responsible and highly paid jobs. However, the automatic systems have shown that these persons are hard workers ready to grab any opportunity; they are more stable, not ready to change jobs frequently and work for smaller salary. A similar situation is in the Western Balkans countries, where a large population of jobless persons over 50 years, called "the victims of the transition", can be found. These people have extreme difficulties in finding a job, but some of them would grab any available opportunity. Similar results are obtained with software based system in the case of persons with disabilities giving them more chances for employment than current legal systems.

VII. CONCLUSION

Progress in the artificial intelligence is non-stoppable and it will continue probably with ability growing at exponentially scale (with frequent setbacks).

Job market will be significantly affected in wider scale and there will be no jobs unaffected; probably jobs related to personal contact and creativity industry will be affected on the smallest rate. Education will pass through extreme changes.

Economy will pass through stressful times as it is common in similar transitions to novel technology. There is possibility that this transition would be even worse than the previous ones.

Security sector will be also affected with more robo-weapons but also with non-state agents bridging gap with respect to standard armies and law enforcement agencies. Pretty worrying.

About humanity. I am not expecting that it will bring less human society than what we are observing nowadays. Off course it means that system will be optimized according to goal set up by humans but in my opinion reaction of autonomous intelligent system would be at least on the same level as current of humans in term of humanity.

I can remember some radio drama about 30 years ago. It was related to World War III. Humans lived in caves deeply underground and war was conducted by robots. Robots returned to shelters to bring news about victories and for repairmen. However, at once an apprentice in Ministry of

defense, unit for Chemical, biological, radiological and nuclear defense tested one a robot coming from ground and he has found that robot is without any trace of pollution. Testing was mandatory but after some time they stopped to conduct it since Earth was clearly uninhabitable for many years. To shorten story, they (and the other side) discovered that for many years robots did not make war but clean planet of pollution. So as Nikola Tesla said that it is not ours to fear from machines but to utilize and master them.

REFERENCES

[1] T. S. Ashton, The Industrial Revolution (1760–1830), Oxford University Press, 1948.
[2] J. L. Hammond, B. Hammong, Skilled labourer 1760–1832, Longams, Green and Co, 1919. Available online at: https://archive.org/details/skilledlabourer00hammiala/page/n7
[3] E. Parson, Electrical History: The 1920s (1920–1929), Jun 2002, Available online at: https://www.ecmweb.com/content/1920s–1920–1929
[4] O. Goldhill, "Humans are born irrational, and that has made us better decision-makers," Quartz, March 4, 2017. Available online at: https://qz.com/922924/humans-werent-designed-to-be-rational-and-we-are-better-thinkers-for-it/
[5] K. P, Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, Cambridge, MA, USA, 201.
[6] C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
[7] M. S. Grewal, A. P. Andrews, "Applications of Kalman Filtering in Aerospace 1960 to the Present [Historical Perspectives]," IEEE Control Systems Magazine, Vol. 30, No. 3, pp. 69–78, May 2010.
[8] L. Fausett, "Fundamentals of Neural Networks Architectures, Algorithms and Applications," Prentice Hall, 1994.
[9] M. Dorigo, T. Stutzle, "Ant Colony Optimization", MIT Press, 2004.
[10] M. Mitchell, An introduction to genetic algorithms, Bradford book, MIT press, 1996.
[11] G. E. Dahl, M. Ranzato, A. Mohamed, G. E. Hinton, "Phone recognition with the mean-covariance restricted Boltzmann machine," In Proc. of Advances in neural information processing systems, 2010.
[12] A. Lovelace, Notes upon L. F. Menabrea's "Sketch of the Analytical Engine invented by Charles Babbage, 1842.
[13] I. Goodfellow, Y. Bengio, A. Courville, Deep learning, MIT Press, 2016. http://www.deeplearningbook.org
[14] Google scholar search term "Deep learning" for last 12 months on 31. 12. 2018. https://scholar.google.com/scholar?as_ylo=2018&q=Deep+learning&hl=sr&as_sdt=0,5
[15] W. C. McCulloch, W. H. Pitts, "A logical calculus of the ideas immanent in nervous activity," Bulletin of Mathematical Biophysics, Vol. 5, 1943, pp. 115–133.

[16] History of Neural Networsk, written for course lecture "The Intellectual Excitement of Computer Science" of prof. Erica Roberts, available on-line: https://cs.stanford.edu/people/eroberts/courses/soco/projects/neural-networks/History/history2.html
[17] Canadian institute for advanced research, grupa za mašinsko učenje. Available on-line: https://www.cifar.ca/research/programs/learning-in-machines-brains
[18] W. B. Knox, P. Stone, "TAMER: training an agent manually via evaluative reinforcement," in Proc. of IEEE International Conference on Development and Learning, 2008, DOI: 10.1109/DEVLRN. 2008.4640845.
[19] K. C. Kiwiel, "Convergence and efficiency of subgradient methods for quasiconvex minimization," Mathematical Programming, Vol. 90, No. 1, Mar. 2001, pp. 1–25.
[20] John Thornhill, "Artificial intelligence: can we control it?" FT Magazine, July 14, 2016, available on-line: https://www.ft.com/content/46d12e7c-4948–11e6-b387–64ab0a67014c
[21] UK healthcare text analytics network, available on-line http://healtex.org/
[22] H. Edwards, D. Edwards, "Your primer on how to talk about the "fourth industrial revolution", Quartz, January 23, 2018. Available on-line: https://qz.com/1090176/how-to-think-about-job-automation-studies/
[23] Marc Bain, "Uniqlo replaced 90% of staff at its newly automated warehouse with robots," Quartz, Oct. 2018. Available on-line: https://qz.com/1419418/uniqlo-cut-90-of-staff-at-one-warehouse-by-replacing-them-with-robots/?fbclid=IwAR3cbqwgdX4kpoCxRwpz6tslegWd2HlNcbQjlQd3YejeEAy3P8OuHilen-I
[24] John Hawksworth, "AI and robots could create as many jobs as they displace," World Economic Forum, Sept. 18, 2018. Available on-line: https://www.weforum.org/agenda/2018/09/ai-and-robots-could-create-as-many-jobs-as-they-displace/
[25] L. Garfield, "7 robots that are replacing farm workers around the world", Business insider, Aug. 12, 2016. Available on-line: https://www.businessinsider.com/robots-that-are-replacing-farm-workers-2016–8
[26] S. Keach, "Fast food restaurants are using ROBOT chefs because they can't find enough workers," The Sun, June 26, 2018. Available on-line: https://www.thesun.co.uk/tech/6625773/burger-robot-fast-food-job-automation/
[27] G. Strauss, "Fast food workers strike for higher pay," USA Today, Aug. 29. 2013. Available on-line: https://www.usatoday.com/story/news/nation/2013/08/29/fast-food-workers-strike-for-higher-pay-in-nearly-60-cities/2726815/
[28] N. Silver, FiveThirtyEight, Available on-line: https://fivethirtyeight.com/contributors/nate-silver/
[29] BambooHR Capterra Recruitment Software, available on-line: https://www.bamboohr.com/
[30] K. Carey, "Here's What Will Truly Change Higher Education: Online Degrees That Are Seen as Official", The New York Times, Mar. 5, 2015. Available on-line: https://www.nytimes.com/2015/03/08/upshot/true-reform-in-higher-education-when-online-degrees-are-seen-as-official.html
[31] J. Littlefield, "The Dark Side of the MOOCs," ThoughtCo, Aug. 21, 2017. Available on-line: https://www.thoughtco.com/problems-with-online-classes-1098085

[32] M. Mirzayanov, Codeforces. com (largest on-line programming contents platform in the world).
[33] M. Chui, "Where machines could replace humans—and where they can't (yet)", McKinsey report, available on-line: https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet
[34] D. Yasa, "Why robots could soon replace our doctors", March 18, 2018. Available on-line: https://www.news.com.au/lifestyle/health/why-robots-could-soon-replace-our-doctors/news-story/9c33db2f25e0fff6184603b38cdc641f
[35] S. S. Sikchi, S. Sikchi, M. S. Ali, "Artificial Intelligence in Medical Diagnosis", International Journal of Applied Engineering Research, Vol. 7, No. 11, 2012.
[36] R. Miller, "Technology can't replace the human touch," TechCrunch, available on-line: https://techcrunch.com/2017/01/15/technology-cant-replace-the-human-touch/
[37] J. Varufakis, Ovaj svet može da bude bolji, Krea tivni centar, 2015.
[38] K. Quach, "AI's next battlefield is literally the battlefield: In 20 years, bots will fight our wars — Army boffin," The Register, Oct. 12, 2018. Available on-line: https://www.theregister.co.uk/2018/10/12/ai_soldiers_fighting/.
[39] T. Zhang, Q. Li, C.-s. Zhang, H.-w. Liang, P. Li, T-m. Wang, S. Li, Y.-l. Zhu, C. Wu, "Current trends in the development of intelligent unmanned autonomous systems," Frontiers of Information Technology & Electronic Engineering, Vol. 18, No. 1, Jan. 2017, pp. 68–85.
[40] T. Gibbons-Neff, "Israeli-made kamikaze drone spotted in Nagorno-Karabakh conflict", The Washingotn Post, Apr. 5, 2016, available on-line: https://www.washingtonpost.com/news/checkpoint/wp/2016/04/05/israeli-made-kamikaze-drone-spotted-in-nagorno-karabakh-conflict/?noredirect=on&utm_term=.deefd64e8891
[41] D. Brown, "Russia says it has deployed its Uran-9 robotic tank to Syria — here's what it can do," Business Insider, May 5, 2016. Available on-line: https://www.businessinsider.com/russia-uran-9-robot-tank-what-can-it-do-syria-2018–5
[42] https://en.wikipedia.org/wiki/Teletank
[43] Army technology, Uran-6 Mine-Clearing Robot, available on-line: https://www.army-technology.com/projects/uran-6-mine-clearing-robot/
[44] Z. R. Bogdanowicz, "Flying Swarm of Drones Over Circulant Digraph", IEEE Transactions on Aerospace and Electronics Systems, Vol. 53, No. 6, Dec. 2017, pp. 2662–2670.
[45] https://en.wikipedia.org/wiki/Three_Laws_of_Robotics
[46] Search ISIS drone attack video at youtube. com, for example https://www.youtube.com/watch?v=bFfq5VpdUV4
[47] I. Djurović, S. Djukanović, "Will technological society be inhuman?," in Proc. of Int. Conf. Transition to a New Society, Podgorica, Montenegro, March 2014, pp. 503–518.
[48] O. Kharkovyna, "How is AI being used in HR & Recruitment?" Medium Corportation technical report, available on-line: https://medium.com/@oleksii_kh/hr-is-your-new-hr-5-example-of-using-machine-learning-in-human-resources-a380ef4a77ff