AI ETHICS

Applications of AI in Transport and Safety

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This course sheds light on the fundamentals of Artificial Intelligence in Transportation System (AITS) and safety and looks at the technologies at play in its implementation. It looks at key issues in transportation and safety and considers AI solutions for identified problems. Emerging areas of research in the field of AITS are also discussed. Professor Jerry John Kponyo hopes this course will generate interest for deeper research into this field of study.

Lecture Transcript

0:06 Hello everyone. Today we want to consider the application of artificial intelligence in transportation and safety. My name is Engineer Professor Jerry John Kponyo, Co-Founder of the Responsible AI Network Africa and Associate Professor of Telecom Engineering at the Kwame Nkrumah University of Science & Technology. In today's presentation, we will begin by looking at the background of the lecturer, myself We will look at what artificial intelligence is and its application to transportation systems. We'll consider the applicant- the technologies which are used as far as artificial intelligence in transportation systems is concerned. Then we will look at within the confines of their transportation systems and safety, what are the key issues requiring artificial intelligence intervention and then we will go on to look at what solutions are provided for as far as IT is concerned. And then, we will conclude as far as this lecture is concerned. To begin with, I just want to introduce you to my university, the Kwame Nkrumah University of Science & Technology. If you happen to be in Ghana, this is the entrance to my university. We have a very beautiful campus with a lot of greenery and a lot of very beautiful environment. And I want to invite each and every one of you listening to me today to come to Ghana so that you can come and visit the Kwame Nkrumah University of Science & Technology. The university was established in 1951 and became a full-fledged university by an Act of Parliament in 1961. The university is located in Kumasi, which is the capital city of the Ashanti Region of Ghana. The student population of the Kwame Nkrumah University of Science & Technology is 83,000. And we currently have a staff population of 840 and over. We currently run programs in six academic colleges, and we have 6 student halls of residence. Now we look at basically what my profile is being the lecturer for this particular course, Artificial Intelligence in Transportation Systems. Like I have already mentioned, my name is Professor Jerry John Kponyo, an Associate Professor of Telecom Engineering. In KNUST I lead the Emerging Networks and Technologies Research Laboratory. And the focus of the research lab is in the area of artificial intelligence, IoT or Internet of Things, and next generation networks. My PhD thesis was in applying artificial intelligence to vehicular ad hoc networks in the University of Electronic Science and Technology of China. I am a Co-Founder of the Responsible AI Network. Something we have worked on as a collaborative initiative with the Technical University of Munich.

4:54 Having given you a background of my university, and my own background, I would like us to move on and look at the substantive issue, which is the lecture at hand. We are considering artificial intelligence in transportation system. Basically, we are looking at the applications of AI to enhance transportation and safety. So, we want to first look at definitions and we want to look at basically when we talk of the term intelligent transport

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systems, what are we looking at? It refers to information and communication technologies, which are applied to transport infrastructure so as to improve the overall efficiency. AITS for short refers to the applications of AI in transportation systems. The key areas of consideration as far as AITS is concerned, we are looking at transport and safety. We are looking at transport productivity, we are looking at transport reliability. And we are looking at informed travel choices. We also look looking at network optimization and then environmental performance within the transport network. AITS and then artificial intelligence what are the technologies involved? In AITS basically we are looking at transportation management and planning. We are looking at electronic toll collection, we are looking at how we have made travelers' information available so, that if anything happens, we will know how we can trace travelers. We are looking at vehicle safety and assisted driving. We are looking at emergency rescue and security. We are considering freight management as well as comprehensive transportation. And finally, we are looking at automatic highway driving. All these are things that are considered as far as intelligent transport systems are concerned. How does artificial intelligence technology assist in making intelligent transport systems possible so and AI or artificial intelligence technology? We are considering knowledge representation methods; we are looking at section and reasoning techniques. We are looking at computational intelligence, we are considering aspect systems, machine learning intelligent agents, intelligent control as well as natural language understanding. These technologies work hand in hand with intelligent transport system technologies to ensure that there is safety in intelligent transport systems. Let us now look at the key problems that are paramount as far as intelligent transport systems are concerned. So that we can see how AI can intervene to solve these issues. The first challenge has to do with an increase in the number of motor vehicles. Basically, what we are seeing is that on a daily basis, there is a significant increase which therefore increases the amount of traffic that we have to deal with as far as transportation systems are concerned. Research has shown that the possession of motor vehicles passes rates 0.279 billion, with that of cars reaching 0.172 billion. So, the Anwar Group and the number of newly registered vehicles have both reached a record high. So basically, what this means or the that, in essence, there is going to be a significant increase in the number of vehicles that we have to manage for which reason there is the need for AI intervention for easy management of the number of vehicles that we are considering globally.

10:12 As a result of the increase in number of vehicles also, there are a number of traffic violations and these are very hazardous some of them leading to loss of lives. The number of motor vehicle traffic violations has surpassed 0.2 billion globally, with the running of the red light, running of red lights, illegal parking, crossing on forbidden lines and speeding on the top of the list, indicating relatively poor safety awareness of drivers. Basically, what this means is that our road networks are becoming less and less safe as far as driving on them is concerned, which means we need to have interventions to make it safer for us to use our road networks. The third problem which requires AI intervention has to do with traffic congestion, which is gradually intensifying on a regular basis. Basically, where there is a lot of traffic, that time is reduced, because there are a lot of delays, which therefore means that there should be a number of interventions based on which we can limit the travel time significantly. In the light of the problem that I've just mentioned, what are the solutions that can be provided for as far as intelligent transportation systems are concerned? About that, yes, we have looked at the whole concept of electronic police, where we have electronic systems, which are regularly monitoring the transportation system and ensuring that people are doing what is expected of them. We also have comprehensive supervision on violations by dome cameras. So, on a regular basis, we are monitoring the transportation system to ensure that the right things are done. Where people violate these regulations, there is evidence by way of pictures which are taken and then they are brought to book. We are looking at Cloud electronic police. And so similar to electronic police in basically what we are saying here is that when it comes to the records of the electronic police, instead of storing it on a stationary server, we are looking at it on the cloud so that irrespective of one's location, we can always have

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access as far as records on surveillance is concerned. We are also looking snapping systems concerning illegal use of specialized lanes. In a transportation system, there are specialized lanes, some which are used for pickup vehicles, others which are reserved for safety purposes. Where people jump these traffic lanes, it is important that there are means through which they are brought to book and AI is able to assist as far as that is concerned. We are also looking at inspection control systems. So, we are automating the inspection so that on a regular basis, we have AI systems that are able to inspect the transport system and provide a report as far as violations are concerned. And finally, we have travelers' information where when people drive our roads, we are able to get a lot of information regarding their background so that in case of any situation, we will know how to track such people. So basically, we are now looking at various solutions. And as I've already mentioned, we look at a number of these, but we want to narrow down and pick a few for your attention. We are looking at solutions provided for intelligent transportation industry. One of them is high resolution smart cameras. Previously, you recognize that if we needed to submit about lessons in evidence, it is important that the quality of the pictures that we submit are very high and so high-resolution cameras or high resolution smart cameras help to be able to take pictures or videos or lessons and then submit them in evidence. And as we are able to call it, if we are able to get a lot of data in this regard, we are able to use artificial intelligence to mine that data to get a sense of the behavior of drivers within a certain period of time, which helps us to be able to make decisions and be able to predict the behavior of traffic users moving forward.

15:32 We are still looking at various solutions and one of them also is intelligent analysis terminal. Intelligent analysis terminal uses AI to provide some additional information as far as traffic users are concerned. One of the things that we are able to get in an intelligent analysis terminal is model recognition. Model recognition helps us to be able to specifically indicate what mode a vehicle is, as far as its usage of the road is concerned so that where there is a violation or where a vehicle is lost and we are looking for it, we are able to use model recognition to guess specifically which vehicle did what on the road. Recognition of body color also helps us to be able to identify a vehicle so that as we automate that system, with model recognition and recognition of body color, we are able to specifically know which vehicle was used for what. We are able to also get logo recognition where we are able to get various markers that are on vehicles to be able to identify vehicles within a huge number of vehicles. License plate recognition also helps to be able to capture the details of a vehicle as quickly as possible. Previously, you would need to scan the license plate and then scan it through a huge database of traffic user's information to be able to know which vehicle did what back when license plate recognition within a split of a microsecond you are able to tell which vehicle did what. We also have space capture and then cutoff. In space capture and cutoff, we are able to best capture and cutoff we are able to know which vehicle has done what. We also have detection of no seatbelt while driving. All these help us to be able to know when people have made violations as far as the use of their traffic system is concerned. We also have detection of using cell detection of using cell phones while driving. So, where people use cell phones while driving, we are able to automate that system such that we are able to identify those who were able who violated site traffic offenses and then detection of yielding to pedestrians. So, when a certain driver refuses to yield to pedestrians and put them in danger, we are also able to determine that or identify that using artificial intelligence. We are still looking at solutions of AI as far as the transportation industry is concerned as a result of AI also, there is a strengthening of traffic security and there are instances where we are able to make snapshots of vehicles to be able to enhance safety as far as the use of vehicles is consent. So, here you will recognize that we are able to detect vehicles following through a yellow light. So, here what it means is that we are able to identify which direction that particular vehicle is moving by using the taillight and then following through with that. Okay, so, we are also able to still try to strengthen traffic safety by plate recognition. So, where for instance a particular vehicle is used in committing a crime, we are able

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to use the plate recognition to identify which vehicle committed which crime. Still on being able to identify the number plate and the type of vehicle we have that additionally also, as a result of artificial intelligence vehicles are now able to give the pedestrians the right of way so that they do not endanger the pedestrians who use a particular traffic system. Once again, as a result of artificial intelligence, we are able to improve on traffic efficiency. And by so doing, we are able to collect data on traffic flow.

20:28 So, we collect a number of traffic flow parameters and do analysis to help be able to predict how much time it will take to be able to make a certain trip. So, we are basically considering information of traffic flow information on traffic flow, we are looking at queuing length and waiting time, we are looking at average travel speed and we are also looking at statistical analysis of vehicle model. This information, once it is available, helps one to be able to predict how much time it will take to get to a certain destination. Still on various solutions that are available AI solutions as part of the transportation network is concerned. We have looked at passenger flow analysis where we actually look at how passengers use a certain stretch of road, we are also able to do key area analysis. We also do pedestrian flow prediction where we are able to predict as a result of the data that is available, we are able to predict how much or how many pedestrians are likely to flow or move in a certain stretch of the road within a certain time interval. Information of neighbor and vehicle flow also helps us to be able to get information regarding vehicles that are driving to the left and to the right of various traffic users. We are looking at passenger volume statistics which gives us an idea of how many passengers are within a certain volume. As far as the route network is concerned, we are looking at evaluation on the rationality of routes, we are looking at early warning of ticket fares, we are looking at smart dispatching of buses and then degree of crowding. All these are able to be able to make determination on it as a result of the introduction of artificial intelligence in intelligent transportation systems. Having said all these and having been highlighted how AI has been used as far as transportation networks are concerned, permit me to throw in some more insight as far as what the recent trends are, as far as transportation systems and AI is concerned. Areas which are still being exploited as far as AI in transportation systems are concerned, we are looking at the whole area of traffic management. I have already said that traffic actually limits efficiency because we end up spending a lot of time on the road. So, if we are able to come up with systems which help us be able to manage traffic more efficiently, then we are able to become more productive because we spend less time in traffic situations. So, using AI incident detection and data collection versus conventional algorithms has become an area of interest as far as research is concerned. So, looking at conventional algorithms, and then looking at AI's intervention, how is AI able to limit the travel time and the travel time as far as transportation is concerned, this is important to us. We are also looking at sensor detection where we have data sets that offer continuous video and sensor reading of data. So, on a regular basis, we are using sensors to collect a lot of information as far as the users of the vehicle the traffic network is concerned. We are looking at how we can effectively manage sensors to be able to do this work for us. We are also looking at pedestrian accessibility, exploring AI and machine learning to transform independent mobility for people with disabilities. So, for people with disabilities, how are we able to use AI to help them as far as the use of the road network is concerned? Then there is the whole issue about automation. How can we equip vehicles and infrastructure with the ability to enable the safer and more efficient movement of goods and services? Automation has also become a key area as far as the application of AI in intelligent transport systems is concerned.

25.08 So, areas that are still being explored in the field have already mentioned, trends in traffic state estimation, and then traffic jam detection is very key. Traffic jam detection is important because when you are about making a journey, you will want to select the lane that is as less traffic with less traffic forming. How are you able to do that is to develop systems that help you be able to determine traffic jams as early as possible. With reference to

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sensor detection, the areas of interest: automotive with night vision, adaptive light control, surround view systems, forward collision warning, lane departure warning, blind spot detection, driver drowsiness detection are all areas that are of interest as far as sensor detection is concerned. Regarding pedestrian accessibility, accessibility, their areas of interest are pedestrian protection systems and then in real time, pedestrian recognition models and algorithms. These are very important as far as pedestrian accessibility research is concerned. In the area of automation within intelligent transport systems, we are looking at traffic sign recognition, how one is able to identify traffic signs and be able to automate like that the vehicles are able to obey the traffic signs without human intervention, we are looking at highway autopilot. So, when you are on the highway, you can put the vehicle on autopilot so that there is no need for human intervention. The vehicle drives you as long as you're on the highway and there is less traffic. Traffic jam autopilot: so, where there is also traffic within the jam, how can you put a vehicle on autopilot so that it navigates you through the traffic network. Then there is also autonomous parking where the vehicle can identify within the space which traffic parking space is available and is able to drive itself to park with less difficulty. So, basically, when it comes to the applications of artificial intelligence in intelligent transport systems, I have used this time that we have spent together to highlight a few of the key issues as far as this is concerned. The expectation is that beyond this lecture, we can go back to the areas of research and identify a certain area that you want to study in so that together we can work to get various solutions as far as AITS is concerned. And so this has been your lecturer, Jerry John Kponyo from the Kwame Nkrumah University of Science & Technology. Thank you.

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