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AUTONOMOUS VEHICLES AND TORTIOUS LIABILITY: AN ISLAMIC PERSPECTIVE

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ABSTRACT

The advent of autonomous vehicles, ongoing trials and the likelihood of operational liabilities from operational accident possess some challenges in major legal systems around the world. Existing tort rules seem unsuitable for the regulation of liability in this circumstance. Attempts are being made to seek regulatory reforms which conform to specific legal environment. Expectedly, Muslim countries and Gulf States in particular might want to consider Islamic law principles and legal norms of the societies in formulating applicable laws. This article is a futuristic and proactive attempt to smoothen the legal riddles surrounding autonomous vehicles from an Islamic jurisprudential perspective. The deductive research technique known in Islamic jurisprudence as qiyās (analogical deduction) is adopted to derive new law for new cases. This paper finds that existing Islamic law rules are capable of providing guidepost for the reception of this technology in Muslim countries.

Keywords*: autonomous, vehicles, qiyās, torts, Islamic jurisprudence*

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INTRODUCTION

The rapid evolution of automotive technology, also known as self-driving or driverless vehicles, the legal environment in different legal systems needs to be determined. Ascertaining the *fiqh* (Islamic jurisprudence) position is capable of impacting its acceptance or otherwise in Muslim countries. Technological inventions through robotics technology play significant role in various ways and in achieving different objectives which may include: enhanced mobility for physically challenged and the elderly, faster service delivery and enhance productivity output. Among other advantages, the technology has been acclaimed for its potential in improving urban parking space and greener environment.[2]

Since the first test-drive of google autonomous car in 2011 which has logged about 300,000 kilometres in 2013, several other car manufacturers including Audi, BMW, Volvo have joined the race for self-driving car technology.[3] After the first test in the United States, other cities around the world including London, Dubai, Singapore, Beijing and Kuala Lumpur are being considered as testing locations. Therefore, temporary permits and regulation might be considered for such experiment in any given state or jurisdiction around the world.[4] The varieties of various legal environments require that regulators must necessarily comply with the domestic laws to suit this new innovation. Islamic law which is a major legal system is one of the laws that has to contend with this new scenario.

The advantages of this innovation can be so emphatic in its ability to grant mobility and freedom to younger, older people and physically challenged who are legally ineligible to drive a car.[5] Apart from enhancing results, saving of time

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2 Nash Islam, 'The Huge Impact Driverless Cars Will Have on Parking & Urban Landscapes,' https://cleantechnica.com/2016/04/11/the-huge-impact-driverless-cars-will-have-on-parking-urban-landscapes/,accessed on 31 August 2015.

3 Erico Guizzo, 'How Google's Self-Driving Car Works,' *IEEE Spectrum Online,* https://spectrum.ieee.org/automaton/robotics/artificial-intelligence/how-google-self-driving-car-works, 18 October 2011, accessed on 31 August 2015.

4 B. Walker Smith, 'Automated Driving: Legislative and Regulatory Action,' *The Center for Internet and Society, Tech. Rep* (2013), http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action, accessed 31 August 2015.

5 Gary Silberg et al., 'Self-Driving Cars: The next Revolution,' *White Paper, KPMG LLP & Center of Automotive Research* (2012), https://home.kpmg.com/be/en/home/insights/2012/08/self-driving-cars-the-next-revolution.html, accessed 31 August 2015.

and money, robots and autonomous machines also help to save lives in day-to-day activities. The time saving ability of the machines is an overwhelming advantage they have over human. According to Peter,[6] autonomous vehicles are advance range of machines which are designed through genetic algorithm or artificial intelligence (AI) capable of taking real-time decisions without human intervention.

The absence of human intervention in the operation and decision making of robots and autonomous machines has attracted some legal challenges for the judiciary and legal minds. It has been mentioned that the use of robots have the effect of reshaping certain legal principles in contract law, agency, criminal law and tort law.[7] Therefore, it can be observed that the new technology creates some legal complexities and uncertainties in several jurisdictions where the question arose with regards to liability or harm resulting from such machines.[8] Araujo rightly observed the notorious slow pace of law in catching up with technological advancements.[9] Liability issues are rarely settled by existing laws until incidents occur and its attendant series of grey areas.[10] There has been growing research interests in the legal perspective for emerging technologies in most civil jurisdictions partly because assumptions on the default application of certain law of tort principles in determining liability could be unjust and difficult. It could also defeat the objective and purpose of law. In countries with dual court jurisdictions which may include Islamic law, this situation could be worrisome where the matter is to be determined under the rules of Islamic law.

It is against this backdrop that the paper examines the liability of robotic torts and autonomous vehicles from the Islamic law perspectives. The paper analyses the nature and characteristics of autonomous vehicle. Attempts are

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6 Peter Vas, *Artificial-Intelligence-Based Electrical Machines and Drives: Application of Fuzzy, Neural, Fuzzy-Neural, and Genetic-Algorithm-Based Techniques*, vol. 45 (Oxford: Oxford University Press, 1999), 33.

7 Ugo Pagallo, 'Three Roads to Complexity, AI and the Law of Robots: On Crimes, Contracts, and Torts,' in *AI Approaches to the Complexity of Legal Systems: Models and Ethical Challenges for Legal Systems, Legal Language and Legal Ontologies, Argumentation and Software Agents* (Berlin: Springer, 2012), 48-60.

8 Stephen T Middlebrook & John Muller, 'Thoughts on Bots: The Emerging Law of Electronic Agents,' *The Business Lawyer* (2000): 341-373.

9 Araujo, L., K. Mason & M. Spring, 'Self-Driving Cars: A Case Study in Making New Markets,' *Report, Big Innovation Centre Lancaster University* (2012), 1-12.

10 Jack Boeglin, 'The Costs of Self-Driving Cars: Reconciling Freedom and Privacy with Tort Liability in Autonomous Vehicle Regulation,' *Yale JL & Tech.,* 17 (2015): 171.

also made to extract tort rules from existing animal tort law under the Shariah. The paper finds that Islamic law is capable of regulating the challenges of tort and product liability arising from autonomous vehicle. It also appraises the potential effect of legislative protection for car manufacturers in Islamic law.

ROBOTS AND AUTONOMY

In order to understand the subject matter of the discussion; it is pertinent to clarify relevant terms such as Robots and Autonomous within the context of this paper. Wagner[11] attempts to define a robot as an autonomous artefact which obtains information by sensing the world around it and uses the information to manipulate its environment to achieve its goals. Autonomy, sensing and manipulation "autonomous" are the essential abilities of robots which are enabled through artificial intelligence (AI).

According to the Robot Institute of America (RIA), "Robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks".[12] The word "Robot" originated from the Czech word "robota", which means labour.[13] Robot has also been defined as an automatic apparatus or device which is capable of performing functions which can ordinarily be ascribed to humans or operates with what appears to be near human intelligence otherwise known as artificial intelligence (AI).[14] On the specific components of robots and its operability, Christaller[15] observed as follows:

> *"Robots are sensumotoric machines for the extension of human mobility. They consist of mechatronic components, sensors and*

[11] Rick Wagner, 'Automation and Robotics: Introductory Robotics Lectures for BCR Summer Camp,' *Breach Cities Robotics Team 294*, http://rjwagner49.com/Robotics/BCR/Automation.pdf, accessed 31 August 2015.

[12] D Kostić et al., 'Collision-Free Tracking Control of Unicycle Mobile Robots,' (in Decision and Control, Held Jointly with the 2009 28th Chinese Control Conference. CDC/CCC 2009. Proceedings of the 48th IEEE Conference on (IEEE, 2009), 5667-5672.

[13] Dragan Kostic, 'Introduction Robotics,' http://www.es.ele.tue.nl/education/5HC99/wiki/images/7/70/Introduction_Robotics_lecture1.pdf, accessed 31 August 2015.

[14] D Kostić et al., 'Collision-Free Tracking Control of Unicycle Mobile Robots,' 5667-5672.

[15] Decker, Michael, 'Service robots in the mirror of reflective research,' *Poiesis & Praxis* 9, no. 3-4 (2012): 181-200.

> *computer-based control functions. The complexity of a robot differs clearly from other machines by the larger number of degrees-of-freedom and the variety and the scope of its behaviours."* [16]

The sensing of the environment as conceived by robot gives it some level of awareness but may not be substantial to make robots accountable for any harm caused by its action. Therefore, there is the need to look at the autonomous feature of the machine in order to consider the extent of human factor behind its actions.

From the robotics systems perspective, autonomy can be understood as a degree of independence which allows a machine to take real-time decisions without necessary human intervention. On the other hand, automation is a predetermined instruction given to a machine to perform bespoke or repeated task until command is terminated through human interference.[17] For instance, the movement of the door of a driverless light rail or underground train, a lever is pushed down at a predetermined time subject to the absence of any door barrier. In this respect, the door is said to be automatic but not autonomous. Where the door opens and closes upon observing its immediate environment, it can be said to be autonomous. In other words, it would have a way of knowing when to shut and when to open.[18] Environmental factors are determinants in distinguishing between automation and autonomy of machines.

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16 Christaller, T. & M. Decker, 'Robotik. Perspektiven Für Menschliches Handeln in Der Zukünftigen Gesellschaft. Materialienband,' *Technikfolgenabschätzung-Theorie und Praxis,* 2001), 107-114.

17 Rick Wagner, 'Automation and Robotics: Introductory Robotics Lectures for BCR Summer Camp.'

18 Siemens AG, Fact Sheet, 'How Does a Driverless Metro System Work?," *Siemens Press* (Munchen, Germany, April 2012), http://www.siemens.com/press/pool/de/feature/2012/infrastructure-cities/mobility-logistics/2012-04-metro-paris/factsheet-how-does-a-driverless-metro-work-en.pdf, accessed 31 August 2015.

AUTONOMOUS VEHICLE TECHNOLOGY AND PUBLIC SAFETY

Despite the scepticism raised by researchers on the autonomous car project,[19] several companies have continued to run tests aimed at ascertaining the efficiency of this self-driving automotive technology.[20] The benefits of this technology could however be far more than its criticisms. Autonomous vehicles have the potential to provide mobility assistance for the elderly and the physically challenged. The cost associated with traffic congestion in major cities could be reduced because riders will be able to perform other tasks.

Safety concerns and accident reduction is one of the major reasons propelling the development of autonomous features in vehicle manufacturing. A recent report by non-profit organisation, Insurance Institute for Highway Safety (IIHS) shows that cars with forward collision warning systems, which warn the driver about an impending crash or apply the brakes automatically, are involved in fewer crashes than cars without them.[21] Other benefits include increased mobility which will in turn, have fuel consumption and carbon dioxide emission reduction.[22]

Similarly, Honda had predicted that by the year 2020, it will sell as many robots as it sells cars.[23] Microsoft founder Bill Gates believes that the robotics

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19 John Leonard, an MIT professor who works on robot navigation does not believe total autonomy is imminent. *"I do not expect there to be taxis in Manhattan with no drivers in my lifetime,"* he said, before quickly adding, *"And I don't want to see taxi drivers out of business. They know where they're going, and - at least in Europe - they're courteous and safe, and they get you where you need to be. That's a very valuable societal role."* Knight, Will, 'Driverless cars,' *Technology Review,* 116/6 (2013): 44-49.

20 Among the companies which are currently testing this vehicle include, Google, BMW, Mercedes, Volvo, Audi among others.

21 The Insurance Institute for Highway Safety (IIHS) is an independent, nonprofit scientific and educational organization dedicated to reducing the losses - deaths, injuries and property damage - from crashes on the nation's roads. The Highway Loss Data Institute (HLDI) shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model. Both organizations are wholly supported by auto insurers and insurance associations.

22 Stephen P. Wood et al., 'The Potential Regulatory Challenges of Increasingly Autonomous Motor Vehicles,' *Santa Clara L. Rev.,* 52/4 (2012): 1423-1502.

23 Kusuda, Yoshihiro, 'Honda develops robotized FSW technology to weld steel and aluminum and applied it to a mass-production vehicle,' *Industrial Robot: An International Journal,* 40/3 (2013): 208-212.

industry is in the same place today as the personal computer ("PC") business was in the 1970s, a belief that is significant given that there are now well over one billion PCs-just three decades after market introduction.[24]

PUBLIC SAFETY ISSUES IN ROBOTIC

Notwithstanding the innovative nature and opportunities in this developing innovation, researchers have identified several potential errors and safety challenges. Thus, tort can be committed in the process of its operation and could lead to legal actions for injury to persons or chattel. This section will examine safety issues in robotic torts.

Robotic torts are harm or accident caused by the operation of robots and autonomous machines. This form of tort can be grouped into three main categories based on its sources or origin: engineering errors, human factor and poor environmental conditions (design defects).[25]

Litigation and liability can result from errors such as robot's mechanics, (loose connections across parts, faulty electronics), errors made by the controller (programming bugs, faulty algorithm) untested environmental conditions among others.[26] As a consequence, robots might, for example, fail to stop, or a robot might achieve high, uncontrolled speed, abrupt motion or acceleration. Accident caused by these errors cannot be predicted even by the most attentive human operator. On the other hand, human accidents, which are more controllable, happen due to various factors, such as inattention, fatigue, inobservance of the guarding procedures, inadequate training programs and incorrect procedures. Similarly, adverse environmental factors such as extreme temperature, poor sensing and visibility in difficult weather or lighting conditions can lead to incorrect response by the robot.[27] Environmental factors

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24 Ryan Calo, 'Open Robotics,' *Maryland Law Review,* 70/3 (2011): 571.

25 Vasic, Milos & Aude Billard, 'Safety Issues in Human-Robot Interactions,' (Robotics and Automation (ICRA), IEEE International Conference, 2013), 197-204.

26 Fagnant, Daniel J. & Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations,' *Transportation Research Part A: Policy and Practice,* 77 (2015): 167-181.

27 Anish Arora et al., 'A Line in the Sand: A Wireless Sensor Network for Target Detection, Classification, and Tracking,' *Computer Networks,* 46/5 (2004): 605-634; Venkataraman Shankar, Fred Mannering & Woodrow Barfield, 'Effect of Roadway Geometrics and Environmental Factors on Rural Freeway Accident Frequencies,' *Accident Analysis & Prevention,* 27/3 (1995): 371-389.

and engineering errors are the most likely causational factors in autonomous vehicles mishaps.[28]

Where an autonomous vehicle causes injury to a bystander or damage to other road users, the pertinent question would be on who lays the liability and to what extent? If the driver, by design, is no longer in control, what happens if the vehicle crashes?. This scenario poses some legal challenges for major legal systems including the Islamic law. Cracking this knot requires an understanding of the mechanism in autonomous vehicles and control. The next part of the paper will attempt to provide legal reasoning from Islamic juristic views.

LEGAL CHALLENGES FOR AUTONOMOUS VEHICLE: AN ISLAMIC PERSPECTIVE

The legal challenges posed by this new technology have proven to surpass the adequacy of existing transport regulations around the world, particularly the Islamic Law. There is the need to prepare the groundwork for autonomous vehicle in every legal system of the world including Islamic legal system. Although legislations are reactive in nature and seem to respond after a new case occurs, Fagnant & Kockelman[29] have identified the need for some sort of proactive regulation to address the issues related to licensing, liability, security, privacy in the new technology.

While it is easily conceivable that there are exceptional situations during which a robot task cannot be completely predicted it can be concluded that malfunctions cannot be excluded, and that the risk of human injury or damage to property is imminent. In such situation, who would be responsible? A quick look at the scenario can point to some persons within the scope of liability. Such person could be the owner of the robot, the operator, the manufacturer, the person who has written the codes for the robot, the injured person himself, or a third party. This raises some uncertainty, for road transport regulators and insurance companies. In addition, there will have to be technical means to clarify any critical situation: the robot has to be identifiable, and it will have a memory of operational history of the robot. Several state legislations in the United States have come up with different regulatory interventions. Legal

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28 Venkataraman Shankar, Fred Mannering & Woodrow Barfield, 'Effect of Roadway Geometrics and Environmental Factors on Rural Freeway Accident Frequencies,' *Accident Analysis & Prevention,* 27/3 (1995): 371-389.

29 Fagnant, Daniel J. & Kara Kockelman, 'Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations,' *Transportation Research Part A: Policy and Practice,* 77 (2015): 167-181.

experts are yet to harmonise the rules for determining liability in case of harm resulting from autonomous robots.[30]

TORT IN ISLAMIC LAW

The classification of torts under the English common law possesses some similarities with the Islamic law but differs in terms of rules of liability. Under the English Common law, all torts are wrong but some wrongs will not be considered as tort.[31] Therefore, tort can simply be defined as a civil wrong which is actionable in law with damages as a usual remedy. The different classifications of tort are: negligent torts, intentional torts and strict liability torts.[32] This implies that any breach of civil duty independent of contract for which compensation may be recoverable is a tort and it shall be governed by the law.

However under Islamic law, the concept of tortuous liability is a phenomenon which generally attracts *ta'zir* (discretionary punishment).[33] That is to say, torts or misdeed or wrongs committed against individual members of the public can attract *ta'zir* where it does not fall under *ḥadd* (prescribed punishments). Similarly, the Islamic law remedy for any given torts which are not expressly mentioned in the *Qur'ān* or *Sunnah* (i.e. neither *qiṣāṣ* nor *diyat)* are subject to liability assessment and the discretion of the *qāḍī* (judge).[34]

ISLAMIC JURISPRUDENCE

Islamic Jurisprudence which is referred to as fiqh *fiqh* in Arabic, encourages Muslims to seek understanding of new cases before passing opinion or verdict.

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30 Gerhard Schweitzer, 'Robotics-Chances and Challenges of a Key Science,' in *17th International Congress of Mechanical Engineering (COBEM 2003), São Paulo, Brasil*, 2003.

31 Tony Weir, *An Introduction to Tort Law* (Oxford: Oxford University Press, 2006), 20.

32 Tony Weir, *An Introduction to Tort Law,* 23.

33 Abdul Basir Mohamad, 'Nervous Shock: Is It Available in the Islamic Law of Tort?,' *The Journal of Rotterdam Islamic and Social Sciences,* 1/1 (2010): 132, 157; Liaqat Ali Khan Niazi, *Islamic Law of Torts* (Lahore: University of the Punjab, 1984), 33.

34 Safia M. Safwat, 'Offences and Penalties in Islamic Law,' *Islamic Quarterly,* 26/3 (1982): 149.

The science of understanding and reasoning in deriving the law is known as *uṣūl al-fiqh*.[35] The term has been recognized in the *Qur'ān* which vehemently condemns those who do not use their senses to reason and understand the guidance. Thus, the *Qur'ān* says:

وَلَقَدْ ذَرَأْنَا لِجَهَنَّمَ كَثِيرًا مِّنَ ٱلْجِنِّ وَٱلْإِنسِ ۖ لَهُمْ قُلُوبٌ لَّا يَفْقَهُونَ بِهَا

"and surely, we have created many of the jinns and mankind for Hell. They have hearts wherewith they understand not..."[36]

(Surah al-A'rāf, 7: 179)

The verse above is an indication for man and jinn to exert effort towards understanding phenomenon around us. In yet another verse, Allah says the inability to comprehend the treasures of the heavens and the earth as a feature of the hypocrites:

وَلِلَّهِ خَزَآئِنُ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضِ وَلَٰكِنَّ ٱلْمُنَٰفِقِينَ لَا يَفْقَهُونَ ﴿٧﴾

"...and to Allah belong the treasures of the heavens and the earth, but the hypocrites comprehend not..."

(Surah al-Munāfiqūn, 63: 7)

These verses portray the significance of *uṣūl al-fiqh* and seeking understanding through human reasoning in day- to-day activities. Technically, *fiqh* is the knowledge of the practical laws of the Shariah that are derived and deduced from specific and detailed evidences of the *Qur'ān* and *ḥadīth*.[37] However, there are certain principles of *uṣūl al-fiqh* that are related to law of torts which are subject to *ta'zir* (discretionary punishment), or which Muslim jurist are permitted to perform *qiyās* (analogical deduction). Such matters under Islamic law include: *ja'aiha* (epidemic regulations) and *al-dama'an* (liability). This has been established from the import of notable traditions reported by Ja'abir where the Prophet Muhammad (PBUH) says:

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35 MH Kamali, *Principles of Islamic Jurisprudence* (Cambridge, UK: Islamic Text Society, 2003), 30; Imran Ahsan Khan Nyazee, *Islamic Jurispudence (uṣūl al-fiqh)* (Malaysia: The Other Press, 2000), 17.

36 All translations of the *al-Qur'ān* are based on Muhammad Muhsin Khan and Taqi-ud-Deen Hilaali, *Translation of the Meanings of the Noble Quran in the English Language* (Makkah: King Fahd Complex For Printing The Holy Quran, 1997).

37 Wael B. Hallaq, *An Introduction to Islamic Law* (Cambridge: Cambridge University Press, 2009), 45-56.

لو بعت من أخيك ثمرا ، فأصابته جائحة ، فلا يحل لك أن تأخذ منه شيئا ، بم تأخذ مال أخيك بغير حق

"If you were to sell fruits to your brother and they are stricken with calamity, it is not permissible for you to get anything from him. Why do you get the wealth of your brother, without justification?..." [38]

This shows the permissibility of varying the Islamic legal position in certain situations including the calamities and presence of uncertainties.

Moreover, under Islamic law, life, properties and honour of individual members of the society is sacred. Therefore, compensation may be payable equal to the damage caused by the tortfeasor, particularly when the act is a direct causation to the damages. The *Qur'ān* is instructive on this point when it says:

وَجَزَٰٓؤُاْ سَيِّئَةٖ سَيِّئَةٞ مِّثۡلُهَاۖ فَمَنۡ عَفَا وَأَصۡلَحَ فَأَجۡرُهُۥ عَلَى ٱللَّهِۚ إِنَّهُۥ لَا يُحِبُّ ٱلظَّٰلِمِينَ ٤٠

"The recompense for an evil is an evil like thereof, but whoever forgives and makes reconciliation, his reward is due from Allah. Verily, He likes not the zalimun (oppressors, polytheists, and wrong-doers, etc).."

(Surah al-Shūrā, 42: 40)

Thus, the use of analogy or *qiyās* in determining the extent of liability and recompense is given approval by the *Qur'ān* and *ḥadīth*. In certain cases, *ijtihād* is also required particularly in new cases such as self-driving or autonomous vehicles.

The Use of *Ijtihād*

In order to arrive at a decision in any new case or situation under the Shari'ah, there are some basic principles to follow. In this instance; new technological innovation requires a certain level of *ijtihād* on the part of the qualified legal expert (*mujtahid)* in order to determine who is liable in case of injury resulting from operation of autonomous vehicles. The process of discovering the law using *qiyās* was enunciated by Wael B Hallaq as follows:

[38] Reported by Imam Bukhari. See Imam Muslim, *Sahih Muslim*, trans. Abdul Hamid Siddiqui (Delhi: Kitab Bhavan, 2000) Book of Transaction, Hadith 3771.

> *"Discovering the law of God was of crucial significance for it was the law that informed man of the conduct acceptable to Allah.' It is exactly for the purpose of finding the rulings decreed by God that the methodology of uṣūl al-fiqh was established. The Qur'ān and the Sunnah of the Prophet do not, as a rule, specify the law as it might be stated in specialized law manuals, but only contain some rulings (aḥkām; pl. of ḥukm) and indications (dalalat or amarat) that lead to the causes ('ilal; pl. of illa) of these rulings. On the basis of these indications and causes the mujtahid may attempt, by employing the procedure of qiyās (analogy) to discover the judgment (ḥukm) of an unprecedented case (far'; pl. furū'). But before embarking on this original task, he must first search for the judgement in the works of renowned jurists. If he fails to find a precedent in these works he may look for a similar case in which legal acts are different but legal facts are the same. Failing this, he must turn to the Qur'ān, the sunnah, or ijmā' (consensus) for a precedent that has (a 'illa) identical to that of the unprecedented case (far). When this is reached he is to apply the principles of qiyās (analogy) in order to reach the ruling of the case in question."* [39]

The basic preconditions for *ijtihād* to be done is that we cannot find the direct *aḥkām* (ruling) or *dalalat* (indications) in the *Qur'ān* and Sunnah; this case has presented a *far* (unprecedented matter) which must be addressed. Therefore, in order to determine the ruling, the *mujtahid* must follow the procedure for analogy (*qiyās*) to determine liability for injury caused by the autonomous vehicle.

Other elements in determining new case are that the *mujtahid* (person qualified to perform *ijtihād*) must search for similar *ḥukm* (judgement) from the existing juristic works. In the similar case the legal act or legal fact must be the same as the new case or at least have same character. Ijtihadic process permits some level of analogy based on existing rules.

Hypothetically, the new case we have at hand is an autonomous vehicle which is presumed to have caused injury during its operation along the road. In addition, we cannot find in the organic law the *aḥkām* ruling for the case and the pre-conditions for *ijtihād*. The author considers this situation as permitting the use of *qiyās* or analogy to solve the problem. Therefore, we attempt to establish the basis for comparison and analogy between animals and robots in

[39] Wael B Hallaq, 'Was the Gate of Ijtihad Closed?,' *International Journal of Middle East Studies,* 16/1 (1984): 3-41.

order to justify the possible application of animal liability in Islam to liability from harm caused by robots and autonomous vehicle.

Animal Tort and Basis for Comparison

Animals are a common means of transportation before the advent of modern machines like cars and aero planes. During its booming days as a major means of transport, it could be accompanied or unaccompanied and used as a beast of burden or a guided means of transporting human. Where injuries or damage is caused by the animal, jurists have developed ways of ascertaining ascribing liabilities and in some cases damages are overlooked.[40] The level of thinking possessed by beast of burden is plausible and does not grant it absolute sense of judgement. As a result, transport animals are usually accompanied by its owner or known to be owned by someone.

For the purpose of ascertaining liability, animals have been classified under the Islamic law. Such classification has been accepted by Muslim jurist based on inherent harm or harmless nature of the specific animal. This comes under the specific rules of animal liability which depends on a distinction made between *al-hayawan al-khatir* (wild animals) also known as *ferae naturae* and al-*hayawan al-adi* (domestic animals) also known as *mansuetae naturae*.[41] In order to justify this position, Muslim jurist have extracted the foundation of liability for owners of animals from the import of few *ḥadīth* of the Prophet which must be distinguished appropriately. There are two opinion based on *ḥadīth*, one argue for the presence of liability and the other asserts the absence of liability. Firstly, the *ḥadīth* which says "no liability is entailed on the animal's act". The second opinion says "its act is not exempted from bearing the liability".

For the first opinion, the *ḥadīth* relied upon are: "Animal's tort by its hind-leg is to be overlooked" [42] and "Injury caused by animals is not actionable."[43]

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40 Linda Kalof, *Looking at Animals in Human History* (London: Reaktion Books, 2007), 33.

41 Earl C Arnold, 'The Law of Possession Governing the Acquisition of Animals Ferae Naturae,' *Am L. Rev.* 55 (1921): 393; Abdul Basir Mohamad, 'Liability for Non-Dangerous Animals: The Scienter Action in English and Islamic Law of Tort,' *Islamic Studies,* 44/1 (2005): 77-92.

42 Sulaymān Abū Dāwud, *Sunan Abī Dāwud*, ed. al-Arna'ut Shu'ayb & Muḥammad Kamil Qurrah Balali (Bayrūt: Dār al-Risālah al-'Alamiyyah, 2009), 196.

43 Abū 'Īsā Muḥammad al-Tirmidhī, *Jāmi' al-Tirmidhī* (Book 7: The Book on Zakat) vol. 2 (Riyād: Dār al-Salām, 1999), *ḥadīth* 642.

The jurist holding this opinion comprised of Hanafi jurist who provide commentaries on the *ḥadīth*: "Injury caused by animals is not actionable", in an attempt to determine its nature and scope. The Hanafi jurists seem to obviously construe the *ḥadīth* in its literal meaning. They maintain that in a case of damage by an animal which breaks loose and moves on its own accord, causing injury to person or property, its owner would not be held liable for its torts by night or by day. They call this kind of animal al-*munfalitah* (escapee).

According to Abdul Basir Mohammad [44] 'the texts of these *ḥadīth* obviously imply that the torts of animals are exempted from bearing any liability whatsoever. Imam Nawawi (d.676H/1277CE) elaborated on such *ḥadīth* by mentioning that if the animal does harm for which its owner is in no way negligent or at the time the animal is not accompanied by its owner, the owner is not held liable whether that occurrence happens in daylight or at night. But, if it is accompanied by its driver or leader or rider, then the liability is to be held.[45]

From the above *ḥadīth,* the Prophet (peace be upon him) explicitly exonerates an animal in itself from liability for lack of capacity because the animal is not accompanied. In relation to autonomous vehicle, where a car is not accompanied by the owner under his control, then the owner is liable. Therefore, it appears safe to hold in support of this opinion that any means of transportation which is accompanied by the owner or driver, the driver will be liable. According to the second opinion of Muslim jurist comprising of Al-Sarakhsī (d.286H/899AD) and Burhan al-Dīn (d. 593AH) who asserts the presence of liability, they rely on *ḥadīth* which says: "He who stationed an animal on one of the ways of the Muslims or in one of their markets and the animal trampled somebody down by its fore-leg or hind-leg, is to be liable".[46]

Al-Shāfi'ī asserts that this *ḥadīth* can be used to restrict the general statement in the first opinion as to the application of the ruling, but what is intended by it is particular. He maintains that the animal's torts are in some instances

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44 Abdul Basir Mohamad, 'The Islamic Law of Tort: A Study of the Owner and Possessor of Animals with Special Reference to the Civil Codes of The United Arab Emirates, Lebanon, Tunisia, Morocco, Sudan and Iraq,' *Arab Law Quarterly,* 16/4 (2001): 333.

45 Curtis E.A. Karnow, 'The Application of Traditional Tort Theory to Embodied Machine Intelligence,' *The Robotics and the Law Conference, Center for Internet and Society* (Stanford CA: Stanford Law School, 2013), 1-18.

46 Al-Shawkānī, Muḥammad Ibn'Alī, *Nayl al-Awṭār*, vol. 5 (Lahore: Al-Muhammadiyya, 1983), 324 or vol. 6, 72. See also in al-Buhutī, Manṣūr Ibn Yunus, *Sharḥ Muntaha al-Irādat*, vol. 2 (Bayrūt: 'Alam al-Kutub, 1998), 429.

to be overlooked and in some others are not to be overlooked. The Mālikī and Ḥanbalī jurist concur with al-Shāfi'ī in this case thereby comprising the *jumhūr* (majority) of the *fuqaha* (Muslim jurists). The *jumhūr* concluded that animal torts are to be overlooked when it acted on its own volition without the negligence of its owner or not in a vicious movement or a rage as in the normal disposition of wild animals.[47]

Based on classification by its inherent nature, autonomous vehicles can be classified into these categories; military drones and fighter jets are undoubtedly members of *al-hayawan al-khatir* or *ferae naturae* due to their inherently dangerous nature. They are not intended for domestic use as it presence in any area may spell doom for its inhabitants. On the other hand, self-driven cars, robots which care for the elderly and the physically impaired are considered under the second division known as *al-hayawan al-adi or mansuetae naturae* due to their domestic and civil use.[48] The Ḥanafī and the Mālikī schools opine that the owner is liable for what a *ferae naturae* animal did after he has been warned by one of the inhabitants of the place to take care of such an animal, and he nevertheless lets it loose and it destroys the animal or the property of another.[49] On the other hand, if an animal of *mansuetae naturae* commits a tort by its own accord unaccompanied by its owner or keeper to another person or his property, should the liability be borne on him? The basic purpose of the law of tort is to define the situation at which a person whose right was denied or interest harmed be compensated. This is very essential in Islamic law as its primary objectives are to maintain justice and balance in the society using basic principle of indemnity to quantify actual damage for the purpose of *qiṣāṣ* (retribution).[50]

THIRD PARTY LIABILITY IN ISLAMIC LAW OF TORT, HUMAN FACTOR AND LEGISLATIVE PROTECTION

Determinant of liability in Islamic law is not difficult to ascertain where the owner is present during the trespass to person or chattel. Although the owner

47 Abdul Basir Mohamad, 'Liability for Non-Dangerous Animals: The Scienter Action in English and Islamic law of Tort,' *Islamic Studies*, 44/1 (2005): 77-92.

48 James E Young et al., 'Toward Acceptable Domestic Robots: Applying Insights from Social Psychology,' *International Journal of Social Robotics,* 1/1 (2009): 95-108.

49 Abdul Basir Mohamad, 'Liability for Non-Dangerous Animals: The Scienter Action in English and Islamic Law of Tort,' 77-92.

50 Niazi, 'Islamic Law of Torts,' 35.

of a vehicle is responsible for any tort committed by the machine, question arose in a situation where the machine is under the control of third party such as a trustee, borrower, hirer, usurper and others.

Relevant to this scenario is the statement of Abū Yaḥyā Zakariyyā al-Anṣārī (d. 925H/1519CE), a Shāfi'ī scholar, who stated that "whosoever accompanies an animal even though he is a hirer or a usurper, is liable for anything which is damaged by the animal, either involving life or property, either happening at night or in daytime." [51] Later scholars further elaborated that whoever is rearing a herd of cow whether as an escort, or trustee is the owner at the particular time. Muḥammad al-Sharbinī al-Khāṭib (d.968H/1560AD) also added that whoever accompanies an animal or animals either he is the owner of the animal, or its hirer or its trustee or its borrower or its usurper, is liable for damage which the animal destroys by treading it down with its fore-feet or its hind-feet.[52]

It can be posited that certain issues relating to liability in animals such as cattle and dogs can be compared related to errors committed by machine or robots. This is because as the animals usually act on their instincts, the responsible person as a rider or owner has much control over its behaviour and actions.[53] On the responsibility of riders of an animal, majority of jurist opined that the rider is responsible for any injury or damage caused by the animal, particularly because he has control over it either for pleasure or business. If the rider stops the animal and it struck its hind causing damage and injury, the rider is responsible. Equally if it threw pebbles or dirt to someone's eyes using its hoofs, the rider is indeed responsible.

On the other hand, the Ḥanafī School opined that the leader of the animal is only liable to the damage caused by the animals using its fore feets while the driver is responsible for the damage caused using the hind feets. However,

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51 Zakariyyā al-Anṣārī, *Fatḥ al-Wahhab bi Sharḥ Manhaj al-Ṭullab* (Bayrūt: Dār al-Ma'rifah, 1994), 100.

52 Abdul Basir Mohamad, 'The Islamic Law of Tort : A Study of the Owner and Possessor of Animals with Special Reference to the Civil Codes of the United Arab Emirates, Lebanon, Tunisia, Morocco, Sudan,' *Arab Law Quarterly,* 16/4 (2013): 333-345.

53 Abdul Basir Mohamad, 'The Islamic Law of Tort : A Study of the Owner and Possessor of Animals with Special Reference to the Civil Codes of the United Arab Emirates, Lebanon, Tunisia, Morocco, Sudan,' 333-345.

where the animal was instigated by a third party to commit the harm, the instigator of the initial action will be liable.[54]

Human Factor and Product Liability

The human factor in autonomous vehicle research points to the duty of care of manufactures/designers of the vehicle and the liability over products.[55] Product liability refers to liability arising from human error during manufacturing or design defect and instructional defect. Design defect is one of the most important cause of liability in tort law. In autonomous vehicles, as with many products the standard in the design process is to the extent of foreseeable risks of harm posed by the product. Manufacturers' error or non-user failures in autonomous vehicle occur in situations such as: coding or system security failure, hacking and interacting with pedestrians and bicyclists.[56] These also include critical components of autonomous vehicles such as the software and navigation systems. Manufacturers have the duty to ensure safety of products through series of utility risk test to reduce chances of error as much as possible.

Between manufacturer and user, it could be uncertain as to who to sue where the car causes damage.[57] In relation to this, it has been found that beyond human factor in autonomous vehicle operation, user confidence in the technology is vital due to the projected possibility of manufacturer error and coding failures which could lead to crashes.[58] Where crashes become imminent and the eventual damage to cartel, property and human, the legal system including the courts needs to be prepared for potential lawsuit.

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54 Niazi, 'Islamic Law of Torts'; Abdul Basir Mohamad, 'The Islamic Law of Tort : A Study of the Owner and Possessor of Animals with Special Reference to the Civil Codes of the United Arab Emirates, Lebanon, Tunisia, Morocco, Sudan,' 333-345.

55 Gary E. Marchant & Rachel A. Lindor, 'The Coming Collision between Autonomous Vehicles and the Liability System,' *Santa Clara L. Rev.,* 52 (2012): 1323.

56 Marchant & Lindor, 'The Coming Collision between Autonomous Vehicles and the Liability System.'

57 Jeffrey K. Gurney, 'Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles,' *U. Ill. JL Tech. & Pol'y* (2013), 247.

58 Brandon Schoettle & Michael Sivak, 'A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia' (University of Michigan, Ann Arbor, Transportation Research Institute, July 2014), 20.

The efforts of classical Muslim jurists (*fuqaha*) in deriving law to emerging situations in the past can be appreciated with the advancement in technology which has birthed self-driving and autonomous vehicles. In the quest to codify autonomous vehicle regulations for Muslim countries, it will be necessary to revisit the relevance of Islamic law and juristic opinion.

Legislative Protection against Products Liability under the Shariah

Due to the quest to encourage technological innovation, there have been calls for legislative protection for autonomous vehicle liability.[59] Legislative protection seeks to exempt product liability from manufacturer of autonomous vehicle by enacting provisions in a statute. This measure seeks to ensure the development of the innovation without the fear of the inhibition by liability issues and law suit.[60] The justification for legislative protection is based on the fact that the manufacturer cannot possibly anticipate every possible scenario the vehicle will encounter. Law suit involving liability may inhibit innovation and continued development of impactful and scientific ideas. Indeed a legislative attempt to protect the human factor in product liability for autonomous vehicle.

On the Islamic position on legislative or protection to exempt manufacturers from liability, the principles of *maslahah*, *maqasid* may be advanced to justify or negate liability. Is the scientific experiment in the interest of *maslahah?* and whether the overall benefit outweighs the perceived harm.[61] If the question is affirmative, the jurist and automotive regulators must determine an appropriate framework for legislative protection for autonomous vehicle. The framework must include the acceptable structure of protection, its limits and when the protection will cease to be inforced i.e. after the autonomous vehicle is fully developed to near harmless operation. Ultimately, a Shariah compliant legislative protection for manufacturer must ensure that due diligence and duty of care is exercised. In addition, *takāful* fund may be appropriated for restoration of person harmed by the autonomous vehicle. Therefore, it seems justifiable to mandate a separate *takāful* for users along with purchase autonomous vehicles.

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59 Andrew P. Garza, 'Look Ma, No Hands: Wrinkles and Wrecks in the Age of Autonomous Vehicles,' *New Eng. L. Rev.,* 46 (2011): 581.

60 David Randal Ayers, 'Tort Reforms and 'Smart' Highways : Are Liability Concerns Impeding the Development of Cost-Effective Intelligent Vehicle-Highway Systems? Final Report' (Charlottesville, Virginia, March 1994), http://ntl.bts.gov/DOCS/ayers.html., accessed on 31 August 2015.

61 S. Zain et al., 'Sustainable Manufacturing Framework from Islamic Perspective,' in *IOP Conference Series: Materials Science and Engineering*, vol. 184 (Bristol, UK: IOP Publishing, 2017), 12054.

CONCLUSION

The potential legal issues which may emerge from the deployment of autonomous vehicle technology are enormous and can prove to be daunting for law enforcement. This paper has examined the Islamic perspective on tortious liability for harm committed as a result of the autonomous vehicle operation. Owners, third party i.e. borrower or the trustee including manufacturers, could be held liable for any harm caused by the machine.. Therefore, it could be said that any robotic tort committed by an autonomous vehicle owned by a person or entity, is not necessarily that its owner would be held liable. In other words, the determination of liability of autonomous vehicle when it causes harm is dependent on classification to be given by scholars based on a particular scenario. Whether or not the vehicle possesses autonomy or artificial intelligence capabilities, the human factor in product liability i.e. design and instructional adequacy are vital under Islamic law. The study found that the product liability laws may be subdued to protect manufacturers of autonomous vehicles and encourage innovative and social impact products. Product liability solely lies on the manufacturer, and may be exempted through legislative protection. Funds or any Shariah complaint product may be used to support users under the legislative protection regime

This paper has attempted to answer some pertinent questions on the role of *mujtahidūn* in deriving new laws from old rulings in Islamic Jurisprudence. It also provides a legal premise for lawmakers and the judiciary in Muslim countries to approach robotic technology cases. Finally, the discussion has shown that the rules of Islamic jurisprudence permit some analogical procedures in providing legal basis for emerging problems. In the context of this paper, autonomous vehicles and its potential harm can be addressed under the existing rules of Shariah based on *qiyās* (analogy). In addition, courts and parliaments in Muslim countries can find a legal basis for determining liability for autonomous technologies and robots within their domestic legislations.

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