Application of IOT Technology in Autonomous Vehicle Industry

[1]Chandrashekhar Goswami,[2]Dr. SonaliRidhorkar
[1][2]Department of Computer Science and Engineering,
G H Raisoni Institute of Engineering and Technology, Nagpur
Email: [1]shekhar.goswami358@gmail.com[2]sonaliridhorkar@gmail.com

Abstract: Due to fast development in the field of Internet of Things (IOT) offers major transformation in the automotive industry from human driven cars to self-driven cars. Introduction of IOT will remodel the automotive industry from monitoring, managing and processing the manufacturing units to the after-sales service to customers. This paper surveys the issues and challenges involved in transformation of automotive industry by using IOT.
Keywords: IOT, RFID, automotive industry, self-driving.

1. Introduction

Because of fast growing techniques, Internet of Things (IOT) concept are expanded in the various industries including automobile industry[1]. IOT are more helpful to achieve higher levels of transformation in the automotive industry.IOT consists of multiple sensors, electronics devices and multiple software, that collects various data and provides various services. This technology provides the connectivity between physical world and virtual world by exchanging data, improves life standards of human[1,2].

It gathers the latest data within the discipline of the supply chain management and RFID techniques, with the combination of other latest Information technologies, are applied in automotive industry to achieve more efficient automotive industry in the area of low cost, low energy consumption and environmental protection[6].

Fig. 1. Autonomous vehicles (Source: economist.com)

Autonomous car is not far from its reality. Self-driving cars already on the road, such as Google car and Tesla car. Self-driving vehicle can control brake, steering and accelerator with limited or

without human interaction[2]. Autonomous vehicles having two types depending on manufacturer:

1) Semi-autonomous: It has a feature to control brake, steering and accelerator, but human is still needed having in full control. It has maximum speed 130 km/h in lane.

2) Fully autonomous: This type of vehicle can move from source to destination without any interaction from human.

IOT technology may be implemented in automotive manufacturing industry in the units of spare parts, finished products, semi-finished products, warehousing, logistics, after-sales service, scrap recycling by tracking and monitoring all series of processes [2].

2. Autonomous vehicle industry ecosystem

Figure 2 depicts the ecosystem of autonomous vehicle industry[2]. It has many players such as Government, Consumers, manufactures, distributor, after-sales service, research & development, Insurance company, Financial bank, infrastructure, training. With the advancements in emerging IOT technology every players of ecosystem must adapt the transformation in autonomous vehicle industry in order to catch the changing world.
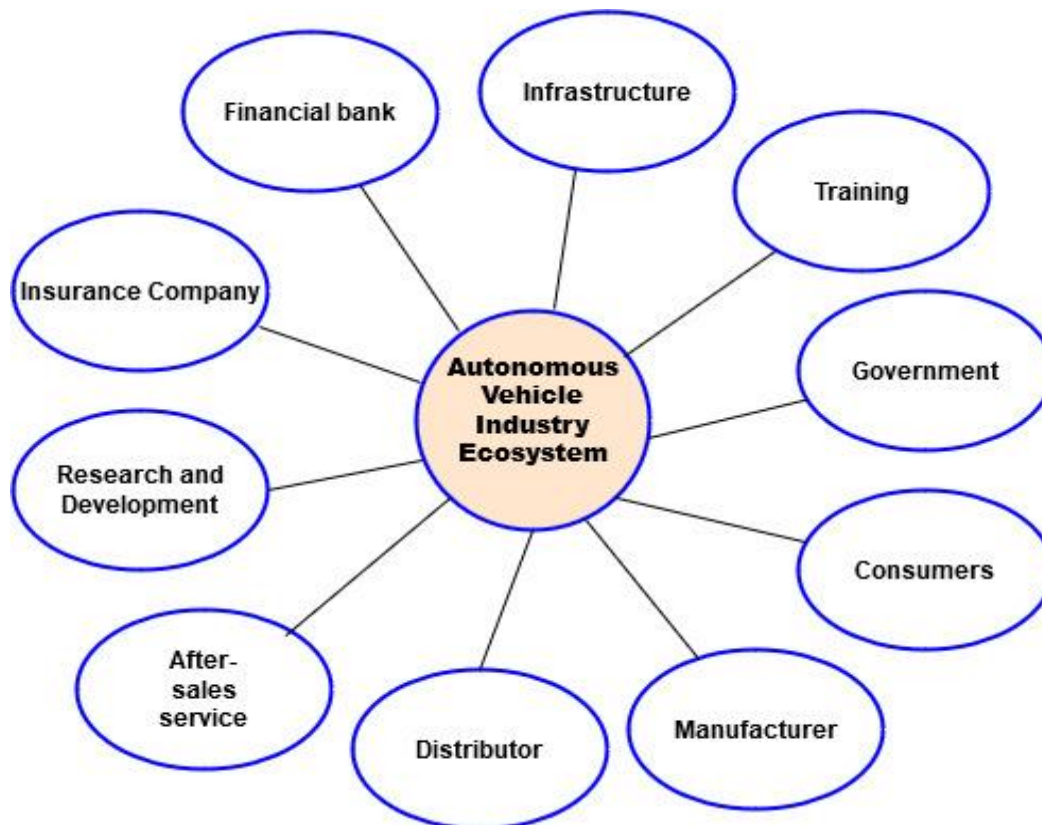

Fig. 2. Autonomous Vehicle Industry Ecosystem

3. Stages involved in Autonomous vehicles

The evolution of autonomous vehicles undergone through four stages depicted in fig. 3.

The evolution of autonomous vehicles involves following stages[3].

- Research and development: In this stage, innovative ideas are proposed but it is not implemented due to unavailability of efficient techniques. This stage may take few years.
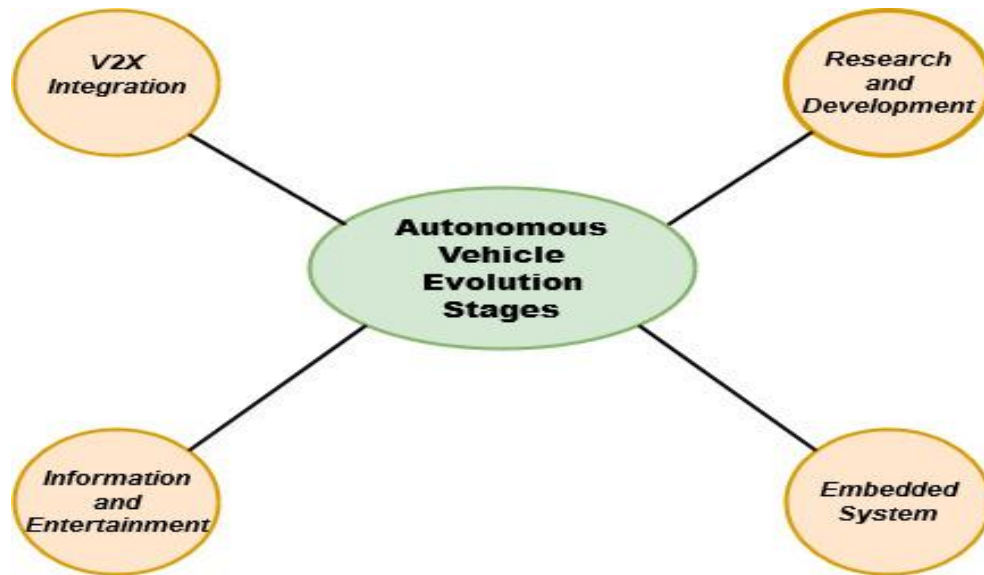

Fig. 3. Autonomous Vehicle Evolution Stages

- Embedded system: This stage involves constituting small electronics modules e.g. mobile phones, sensors in the car for communication purpose.
- Information and entertainment: Introducing an application related to information sharing and entertainment in autonomous vehicles, involved in this stage. New software providers and third-party app provides are actively involved in it.
- V2X integration: At this stage, various sensors, gadgets and smart devices are integrated together to communicate with other vehicles and shares the information within this integration module are called as V2X integration. This integration module is helpful to make communication among other vehicles.

4. Advantages and Disadvantages of Autonomous vehicles:

The advantages of autonomous vehicles are:

- Improved road safety:
  - ➢ There will be fewer road accidents as no human error involved.
  - ➢ The National Crime Records Bureau (NCRB) 2019 report states that 151,417 deaths in India due to road accidents.
- Better mobility:

- ➢ It will provide better mobility to the young and disabled persons.
- ➢ It will provide independent mobility as no drivers required.
- Reduced traffic congestion:
  - ➢ Traffic jam is usual problem now in peak hours. Traffic flow will be efficient, ultimately congestion reduced.
  - ➢ Peoples can utilize their time by involving in something else.
- Reduced fuel consumption:
  - ➢ Pollution will be reduced as congestion reduced.
  - ➢ As congestion reduced, fuel consumption will be less.

These advantages are relevant to under-developed or poor countries to reduce road accidents, but poor road infrastructure may be delayed implementation.

On the other side, disadvantages are:

- Impact on socio-economical aspect
  - ➢ unemployment issue for persons involved in driving profession.
  - ➢ Increase in price of vehicles.
- Enhancement in road infrastructure required.
- Conflict in claim insurance
  - ➢ In the accident, mostly liability attributed to vehicle driver, but in case of autonomous vehicle, there is no such provision.
  - ➢ may be liability attributed to manufacturer, software provider or vehicle owner.

5. Key issues in autonomous vehicles

- Reliable software
  - ➢ flawless software required, to be sure that no error will occur.
  - ➢ Any software issue will be fatal for vehicle owners and users.
- Good navigational system
  - ➢ Good navigational system creates virtual maps to recognize the surrounding things and objects.
  - ➢ This is helpful to autonomous vehicles to find out routes and obstacles into that route.
- Good sensors
  - ➢ Sensors are used to sense physical characteristics to predict various situations.
  - ➢ They are used to differentiate between harmful situation and useful situation.

6. Radio Technologies involved in autonomous vehicles

Various wireless technologies can be implemented in autonomous vehicles such as 5G, DSRC and RFID.

5.1 5G (Fifth Generation Wireless System)

5G[5] technology can be used for vehicle to vehicle data sharing and efficient communication among them. It has low latency. It can be used in the field of information and entertainment, reporting technical issues to the manufacturer. This technology will be useful to keep vehicle firmware updated.

5G technology can run over pre-existing cellular infrastructure and has unified connectivity standard. It will incur low cost by avoiding market and technical fragmentation.

5.2 DSRC (Dedicated Short Range Communication)

DSRC[5] allows two-way data transmission. It has 5.9Ghz band and 75MHz of spectrum. DSRC will require roadside stations to make communications. DSRC may exist with 5G technology. It can serve as backup system to 5G.

5.3 RFID (Radio Frequency Identification System)

RFID[6] is technology that enables computers or machines to recognize objects and control them through radio waves. It was firstly introduced by Soviet Union in 1945. This technology was used in World War II to recognize enemy's aircraft.

RFID system consist of various transmitters and receivers. These are equipped with antenna and microchip to track and monitor objects and data acquisition.

7. Conclusion

This paper studied and analyzed the importance of IOT technology in the autonomous vehicles manufacturing, focused on autonomous vehicle ecosystem. IOT technology will transform the autonomous vehicle industry as it has huge market potential. By adopting such perspectives of ecosystem, we can see autonomous vehicles running on the roads in the future.

This paper covers a broad key issues facing by autonomous vehicle industry. On the side of radio technology used in it, DSRC, RFID and 5G will play big role in the field of vehicle to vehicle communication with all safety measures.

However, autonomous vehicle industry is a new industry which do not have any good theoretical basis for its development, so it is necessary to provide help and active support in the form of cooperation and efficient communication from telecommunication industry, from government statutory bodies in form of better policies and funding.

We can believe that relevant government statutory bodies and major players involved will exchanges and positive cooperation in the near future, so autonomous industry expand its business; our life may change drastically as result.

References

[1] Liu Tenghong, Yuan Rong, Chang Huating, "Research on the Internet of Things in the Automotive Industry" International Conference on Management of e-Commerce and e-Government 2012. DOI 10.1109/ICMeCG.2012.80

[2] X. Krasniqi, E. hajrizi, "Use of IoT Technology to drive the Automotive Industry From connected to Full Autonomous Vehicles" IFAC (International Federation of Automatic Control), 2016. DOI 10.1016/j.ifacol.2016.11.078

[3] Debasisbandopadhyay, JaydipSen, "Internet of Things: Application and challenges in Technology and standardization" Wireless Pers Communications, 2011. DOI 10.1007/s11277-011-0288-5

[4] Mario Gerla, Eun-Kyu Lee, Giovanni Pau, "Internet of Vehicles: From Intelligent Grid to Autonomous cars and Vehicular Clouds", IEEE World Forum on Internet of Things, 2014.

[5]Mohammad RubaiyatTanvirHossain, Md.AsifShahjalal, NowrozFarhanNur, "Design of anIoT BasedAutonomous Vehicle with the Aid of Computer Vision",International Conference on Electrical, Computer andCommunication Engineering(ECCE), Cox'z Bazar,Bangladesh, February 16-18, 2017.

[6]Minghe Yu, Dapeng Zhang, Yurong Cheng, MingshaunWang, "An RFID Tag based Automatic VehicleIdentification System for Traffic IOT Applications", *Control and Decision Conference (CCDC), 2011 Chinese,4192-4197*

[7] Li Da Xu, Wu He, and ShancangLi,"Internet of Things in Industries: A Survey" IEEE transactions on industrialinformatics, vol. 10, no. 4, November 2014 oung, The Technical Writer's Handbook. Mill Valley, CA: UniversityScience, 1989

[8] VivekanandGopalkrishnan, David Steier, Harvey Lewisand James Guszcza*, " Big Data, Big Business: Bridging theGap"*, Big Mine'12, August 12, 2012, Beijing, China.

[9] Advancing Discovery in Science and Engineering.Computing Community Consortium. Spring 2011.

[10] Advancing Personalized Education. Computing CommunityConsortium. Spring 2011.

[11] James Manyika, Michael Chui, Brad Brown, JacquesBughin, Richard Dobbs, Charles Roxburgh, and Angela HungByers. "Big data: The next frontier for innovation,competition, and productivity", McKinsey Global Institute.May 2011.

[12] Application Developer Alliance, "Internet of Things:Automotive as a Microcosm of IoT", 2015.

[13] Atzori, L., Lera, A., &Morabito, G. (2010). The internet of things: A survey. *ComputerNetworks,54*(15), 2787–2805.

[14] D. Conzon et al., "Industrial application development exploiting IoTvision and model driven programming," in Proc. ICIN, Paris, France,2015, pp. 168–175.

[15] A. Le et al., "The impact of rank attack on network topology of routingprotocol for low-power and lossy networks," IEEE Sensors J., vol. 13,no. 10, pp. 3685–3692, Oct. 2013.

[16] L. De Souza et al., "SOCRADES: A web service based shop floor integration infrastructure," in The Internet of Things. Berlin, Germany:Springer-Verlag, 2008, pp. 50–67.

[17] F. Jammes and H. Smit, "Service-oriented paradigms in industrial automation," IEEE Trans. Ind. Informat., vol. 1, no. 1, pp. 62–70, Feb. 2005.

[18] M. Eisenhauer, P. Rosengren, and P. Antolin, "A development platformfor integrating wireless devices and sensors into ambient intelligencesystems," in Proc. IEEE 6th Annu. Commun. Soc. Conf. Sensor, Mesh AdHoc Commun. Netw. Workshops, 2009, pp. 1–3.

[19] S. Nakajima, Introduction to TPM, Total Productive Maintenance.Cambridge, MA, USA: Productivity Press, 1988.

[20] S. E. G. da Costa and E. P. de Lima, "Uses and misuses of the 'overallequipment effectiveness' for production management," in Proc. IEEEIEMC, 2002, vol. 2, pp. 816–820.

[21] Y. Gu, A. Lo, and I. Niemegeers, "A survey of indoor positioning systemsfor wireless personal networks," IEEE Commun. Surveys Tuts., vol. 11,no. 1, pp. 13–32, 1st Quart. 2009.

[22] D.Culler, "10 Emerging Technologies That Will Change the World,"Technology Review, pp.33-49, Feb., 2003.

[23] Y.X.Lu, T.B.Chen, Y.Meng, "Evalutionguideling system and intelligentevaluation process on the Internet of Things," American Journal ofEngineering and Technology Research, vol.11, no.9, pp.537-541, 2011.

[24] O.Bang, J.H.Choi, D.Lee and H.Lee, "Efficient Novel Anti-collisionProtocols for Passive RFID Tags," Auto-ID Labs White Paper WPHARDWARE-050, MIT, Mar.2009.

[25] J.Banks, M.Pachano, L.Thompson and D.hanny, RFID Applied, NewYork: John Wiley & Sons, Inc., 2007.