Simulation of IoT Enabled Automatic Parking Assistance System

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ABSTRACT

Automatic parking system is a popular research topic. The objective of the proposed system is to simulate an automated system tends to park the vehicles safely and quickly when the driver is in medical emergency. The microcontroller unit and the automobile sensors of the IoT network are the prime factors involved in managing the safest parking of the vehicle. It controls the ON and OFF states of the ignition as soon as the panic button is pressed by the driver. It also checks for the nearby free space to park the vehicle safely. An additional feature makes the system more valuable by alerting the nearby vehicles so that minor and major accidents are avoided. It also alerts the co-vehicles to free the roadway to the vehicle which is in emergency. The automated system is designed to automatically place a phone call to the family members or friends intimating the medical emergency of the driver. It provides an optimum and controlled solution with maximum precision. Machine learning and Internet of Things are the technologies incorporated in order to develop the complete system more effectively. The proposed system is highly a user-friendly and reliable prototype, useful for the drivers who are in emergency.

Key points – Automatic parking, Microcontroller, Automobile Sensors, Machine Learning, Internet of Things

I. INTRODUCTION

To enhance the significance of any automatic parking assistance system, the expected measure should easily be available and/or renewed by a workflow model for example the use of sensor networks. A special feature of this proposed emergency parking assistance system is that it could harness the physical variables by using the available materials and is adaptable to both domestic and commercial automobile production. The major advantage of the system is that it could lead to an accident-free environment, systems that are involved in alerting the co-vehicles and safeguards the driver during emergency parking.

Automatic parking assistance system plays an important role in the overall automobile safety upbringing, especially to assist any emergency. The conventional systems of the automobile industry make use of identifying the safest parking slot to park the vehicle [1]. This conventional method assists effective parking but it cannot help the driver during emergency. The proposed research article is based on Machine learning and Internet of Things, which effectively aids the driver to park the car safely and also, alerts the co-vehicles and co-passengers to stay away from the vehicle which is in high risk. It provides maximum safety to the road environment. Precise and consistent control of physical variables is essential for good results. It is a difficult process, but requires an input trigger from the driver to ensue further, to park the vehicle safely.

Automatic parking assistance system is an existing technology in United States of America and other European countries but inadequate commercial systems

limit the expansion and make the products, for instance automatic parking option. At the moment, few commercially owned automatic parking systems provide fewer features during emergency. Majority of these vehicles have little or no access to the existing automatic parking system. Generally, the driver has to identify and assist the parking area and the vehicle is parked automatically based on the free slot characterize the condition of the vehicle safety in USA and other European countries. These hamper and adversely affect the establishment of safety outfits in the automobile industry [2]. Therefore, this study is aimed at the design, development and testing in order to provide a favorable environment for vehicle and driver safety. The developed system will be tested to assess its performance. The results with further improvements can make the developed system to be adopted at all the levels of automobile industry.

In India, no manufacturers are involved in manufacturing an automatic car parking assistance system to ensure complete safety for the driver and the nearby vehicles during emergency. It is mandatory while developing any automatic car parking system so as to avail much essential facilities for the driver to park the car safely and also to alert the co-vehicles and co-passengers to stay away from the risky vehicle. It has to provide highest safety to the road environment. Precise and consistent control of physical variables is essential for good results. Currently, Acumen track UC600 is a GPS device available in the automobile market in order to track the location of the vehicle in emergency [3]. The drawback of this system is, the driver has to identify the safest parking location manually before pressing the panic button. Automatic parking is not possible in this existing device. Mobile application panic buttons exist to safeguard the drivers but not much reliable due to Android platform [4]. The proposed system is aimed to resolve the major issues faced by the drivers during the time of emergency or any other help required in terms of automatically parking the car safely.

II. SYSTEM DESIGN

The finest objective of the system is to save the vehicle drivers in need of emergency. The provision of having a panic button in the vehicle aids the drivers to safeguard themselves from any accidents and also to meet any medical emergencies. The complete flow diagram of the proposed parking assistance system is shown in fig 1.Triggering of the panic button is the foremost step involved in the process and this triggers various other operations of the complete design. Once the panic button is pressed, the control shifts to the main module and automatically switches the hazard button so as to alert the co-vehicles that the driver is in need of emergency aids. This particular operation is handled by the microcontroller unit as interrupted events and executes the corresponding exceptions [5]. Synchronously, it unlocks the doors of the vehicle, and the glasses of the windows are shuttered down. The Reed sensor senses this motion and controls the locking and unlocking actions [6]. This intimates and helps the co-vehicles to identify the need of the emergency. Seat belt is the next prime factor released instantly so that the driver is free before he/she gets help from others.

The high impact factor of the complete system is to decrease the speed of the vehicle gradually. It involves two steps; the first step is to decrease the speed of the vehicle to the minimum and it is controlled by the vehicle speed sensor. It measures the speed of the wheel aiming on the transaxle output and takes the communication to the vehicle's engine computer. The control unit regulates constraints related to vehicle speed. The variables include ignition timing, air intake, and the air to fuel ratio among others. The second step is to shift the gear down to the minimum so as to easily park the car idle and it is accomplished by a transmission solenoid [7].

Updating the life-threatening condition of the driver to the nearby control room by placing an emergency call is the next important element of the drive module. This particular action allows the driver to get immediate assistance faster than usual. This is performed and managed by the GSM and GPS modules and the microcontroller unit of the IoT network. The next interrupt service is to automatically facilitate the video call in order to connect to the nearest hospital and to the high prioritized contact saved in the driver's phone so that the doctors view and hear the decisive condition of the driver. The key objective of placing an automatic call is to help the driver before reaching the hospital.

As a final point, before the help reaches the driver from the above-mentioned community, the temporarily converted autonomous vehicle and its sensor network activates the obstacle detection module to sense the obstacles around the vehicle. This is performed by the industrial IoT ultrasonic sensors, which detect the obstacles for smooth and efficient working in order to

avoid accident and collision [8]. Also, the specially designed ROBOG, an image-based detection system that is meant

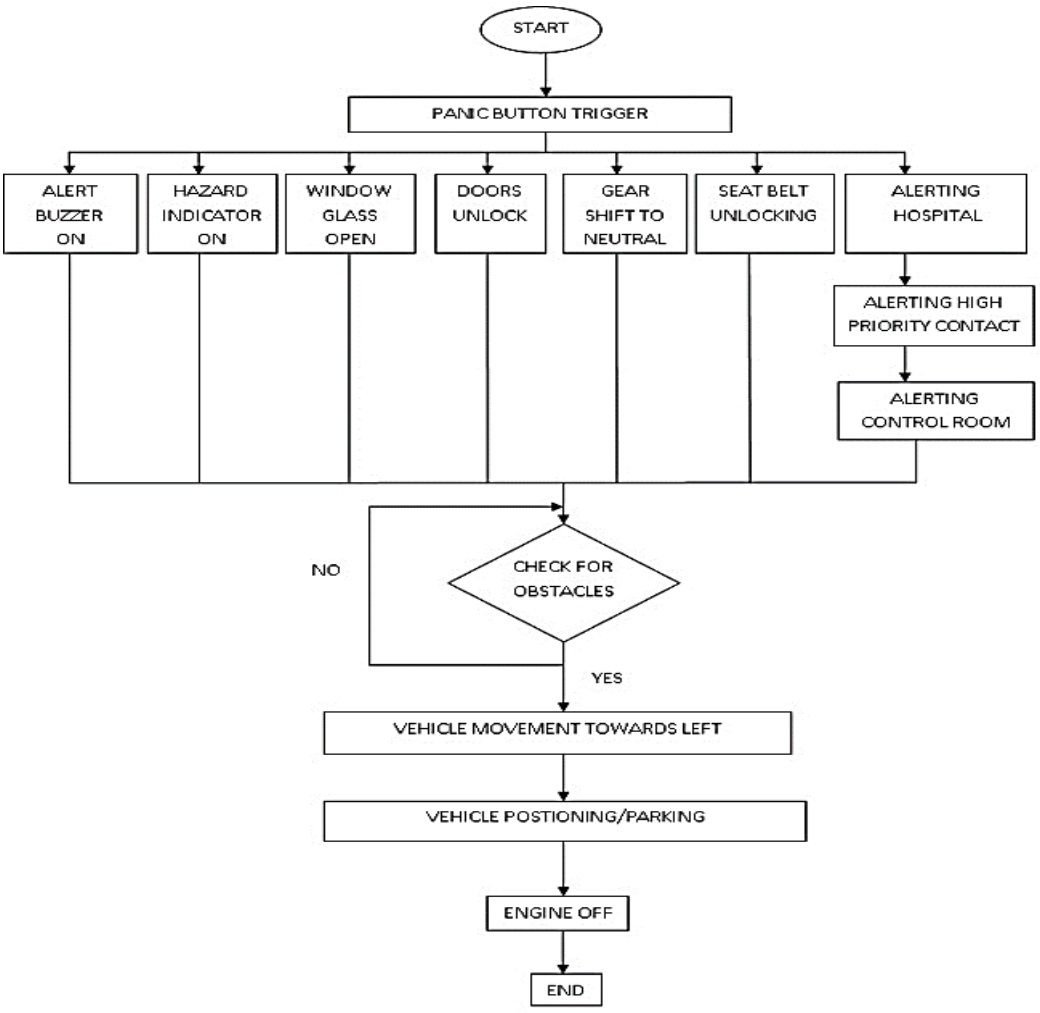

Figure 1 Flow Diagram

for road detection of unstructured roads is activated to find the free space to park the vehicle safely. Along with these modules, the steering angle sensor (SAS) determines where the driver wants to steer, matching the steering wheel with the vehicle's wheels. Located within the steering column, the steering angle sensor always has more than one sensor packaged together in a single unit for redundancy, accuracy, and diagnostics [9]. The IoT enabled assistance system after completing all the indispensable tasks, the ignition of the vehicle is automatically turned off by passing an interrupt signal or token to the ignition control module (ICM). It is accomplished by collecting information from the triggering devices such as the crankshaft position sensor or camshaft position sensor in order to determine your vehicle's base ignition timing [10]. Knowing the importance of the proposed system, it is first simulated before the start of implementation. This gives an apparent direction to work further to construct a complete model.

III. RESULT AND DISCUSSION

The proposed IoT enabled automatic parking system is simulated using MS-EXCEL and R. The idea of simulating the system before implementation has given a appropriate solution in terms of efficiency and accuracy. From fig 1, the actions of the system need to perform, either manually or automatically are tabulated in table 1. Among these, it is observed that there are seven activities which cannot be assumed as deterministic but should be

random as there are communication network based work involved in the system. The other activities, though they can also be in reality presumed as random, it is safely assumed as deterministic, without loss of generality. For the computation purpose, the logical assumptions are generated for the time taken for each of the factors and it is shown in table 2.

S.No	ACTION	TYPE	TECHNOLOGY
1	Panic button trigger	Manual	Mechanical
2	Alert buzzer ON	Auto	Mechanical
3	Hazard Indicator ON	Auto	Mechanical
4	Window glass open	Auto	Mechanical
5	Doors unlock	Auto	Mechanical
6	Gear shift to neutral	Auto	Mechanical
7	Seat belt unlocking	Auto	Mechanical
8	Alerting nearby Hospital	Auto	AI /DataBase
9	Alerting High priority contact	Auto	AI /DataBase
10	Alerting control room	Auto	AI /DataBase
11	Check for obstacles	Auto	AI
12	Move Vehicle to left to park	Auto	AI
13	Position vehicle /Park	Auto	AI
14	Engine off	Auto	AI/Mechanical

Table 1: System Action Plan

After performing 25 reruns of 200 runs each, the average time taken to complete the whole process, using simulation by MS-Excel, is obtained as 79 seconds and it is shown in table 3.The same process, when simulated using R, the system has obtained the following summary after 5000 runs, to go in line with the above number of iterations using MS-Excel.

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
72.2	115.9	139.7	139.3	162.3	210.3

So, again using the basic idea of Statistics, we use the averaging to conclude that the average time taken to complete the panic button triggering process would be in the boundary [79, 140] seconds.

Step no	Activity no	Type	Assumed seconds	Distribution
s1	1	Random	(1-3)sec	Uniform
s2	2,3,4,5	Deterministic	2sec	
s3	9	Random	1-2 sec	Uniform
s4	10	Random	5-20sec	Uniform
s5	8	Random	5-30 sec	Uniform
s6	11	Random	2-5 sec	Uniform
s7	12	Random	30-120sec	Uniform
s8	13	Random	10-30sec	Uniform
s9	6	Deterministic	2sec	
s10	7	Deterministic	2sec	
s11	14	Deterministic	2sec	

Table 2: Logical assumptions

Simulation of Panic Button Triggering Process using MS-Excel										
Sim Run No	1	2	3	4	5	6	7	8	9	10
Time(Sec)	139	8	122	57	97	89	123	99	31	82
Sim Run No	11	12	13	14	15	16	17	18	19	20
Time(Sec)	39	93	53	13	58	111	103	94	55	67
Sim Run No	21	22	23	24	25	-	-	-	-	-
Time(Sec)	78	103	88	42	131	-	-	-	-	-

Table 3: Simulation using MS-Excel

IV. CONCLUSION

The construction of any safety device in the automobile industry is not an easy task. Prototyping the product before commercialization is a challenging work in the industry. This proposed system is also a prototype guarantees maximum safety to the vehicle drivers during medical emergency in terms of safe parking and alerting the co-vehicles on the roadway. The existing parking assistance system available in the market helps to track the emergency vehicle and turns off the ignition and no other attributes are carried out thus not providing the safest parking.

The proposed system deals with various factors mentioned above using sensor networks along with Internet of Things and Machine Learning. The luxury cars having auto-pilot mode in order to safe guard the driver and but not affordable to the public. Also, it is not detachable and thus not budget friendly. The proposed system resolves the cost factor and the portability. The various modules of the proposed system is simulated before implementing the prototype and then the commercialization as a product. After testing the physical factors using MS-Excel and R, it is safe to conclude further that we could perform such a process in around 2 minutes which is a reasonably quick time as it also includes the time where we had activated help call from a hospital and at least one known person which, from a reality perspective is a good initiation. These are the reasons transform the proposed system very unique and highly useful to the drivers who are really in need of medical emergency.

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