Implementation of Vehicle Tracking and Accident Detection System Design Using MSP430 MCU with MySQL

Dakshi Goyal, Divyashree Jena, Jasdeep Kaur, Maninder Kaur

Abstract— Accidents, one among leading causes of loss of life, are unplanned, unpredictable, and circumstantially avoidable. Vehicular accidents account for one of the leading causes of deaths in the metropolis, owing mostly to the carelessness or absent-minded driving techniques of the victim(s). Substance abuse and alcohol are also leading causes of road crashes. Accidents call for dire need for urgency in acquiring help during the emergency. This requirement for quick solutions to such high-risk situations calls for the involvement of innovation. This paper showcases the Vehicle Tracking and Accident Detection system which is designed using the MSP430 microcontroller. Prototype of an accident detection system using vibration sensor as the detector is proposed in this work. This paper also sheds light on the possibility of using this prototype in the form of a company/firm, governed by a hospital, that maintains a database of its customers.

Index Terms— accident, detection, MSP430, MySQL, vehicle, vehicle tracking, microcontroller

1 INTRODUCTION

ACCIDENTS call for a dire need for urgency in acquiring help during the emergency. The nature of injuries sustained by the passengers is unpredictable. As indicated by an ongoing review by WHO revealed in Times of India, India is on first position around the world as far as losses happened because of road accidents. [1]. What is seen in the greater part of the cases is that the mishaps end up being setbacks not on account of the gravity of the mishap however the absence of quick help or help at the correct time. Hence, it is important to get help immediately, medically, via law enforcement or through family and friends. Therefore, it is the need of the hour to be equipped with a technology which tracks and detects an accident easily and thus, reduces the death rate.

In the past, there have been a few methods developed to provide solutions to detect and track the accident. Thomson proposed a smart phone-based accident detection system in which by the built-in sensors of the Smartphone like accelerometer and compass an accident will be detected and then its notification will be sent. But the problem with these kinds of systems is their accuracy problem with their sensors which thereafter give rise to false alarm conditions and do not detect all the accidents efficiently [2] The framework in [3] save the message as well as report with intersection using metadata registry. A coincidence detection method in road [4], make use of CCTV which often see movement of auto trace. However, this technique monitors the main targeted visitors' moves that are fitted with a lot of loop openings during its execution. Due to the loopholes a few brand-new automated incident detections as well as credit reporting approaches evolved. Most of these devices are primarily focused on some wheeler cars. The actual automated incident detection approach which often uses an air case sensor as well as an accelerometer to help diagnose an accident ended up put forward by M. Chuan- Zhietal [5]. Another method for accident detection was manual accident detection based on passengers notifying concerned emergency authorities or nearby hospitals while passing by the accident spot. However, this method didn't turn out to be reliable as it leads to delay and inaccuracies to witnesses' expression problem.

A new method is proposed in this paper which helps in the tracking of the vehicle and detection of the accident. Here, the MSP430 microcontroller is used which senses the occurrence of the accident via the vibration sensor. The GPS module is used for locating the vehicle for mapping the coordinates of the detected accident, and the GSM module for sending the location acquired by the given module to the contact information of the customers' emergency contacts, respectively [6]. At the same time, the database of the customer is maintained who gets this accident detection system installed in their vehicles. The database is used to extract the unique customer IDs and details and possible accident detection locations in the form of coordinates, respectively. This paper presents an accurate, low power, cost effective and efficient accident detection and tracking system. In Section II, equipment and software used for proposed work is presented. Section III outline the proposed work and methodology whereas section IV describes the results. Paper is concluded in section V.

- *Dakshi Goyal is a graduate from Department of Electronics and Communication, Indira Gandhi Delhi Technical University for Women, New Delhi, India. E-mail: goyaldakshi@gmail.com*
- *Divyashree Jena is a graduate from Department of Electronics and Communication, Indira Gandhi Delhi Technical University for Women, New Delhi, India. E-mail: divyashreejena97@gmail.com*
- *Jasdeep Kaur, currently working as Professor in Departrtment of ECE, Academic Dean Affairs, Indira Gandhi Delhi Technical University for Women, New Delhi, India. E-mail: jasdeep@igdtuw.ac.in*
- *Maninder Kaur is currently working as Assistant professor in ECE department, Guru Tegh Bahadhur Institute of Technololgy, GGSIP University, New Delhi, India. E-mail: maninderkaur.gtbit@gmail.com*

2 Equipment and Software Used

2.1 The Microcontroller — MSP430G2553

Texas Instruments' MSP430 [7] group of ultra-low□power microcontrollers comprise of many devices that includes totally different sets of peripherals targeted for numerous applications. The design, combined with five low-power modes, is improved to attain extended battery life in applications based on portable measurement. MSP430 uses Energia IDE that uses embedded C++, catered to the usage of specific TI ICs, as the programming language for implementing the codes that can be executed via the software. Because of such unique features MSP430G2553 has been used.

The MSP430G2553 microcontroller is ultra-low□power mixed signal microcontrollers which has built-in versatile analog comparator, 16-bit timers, built-in communication capability using the universal serial communication interface and up to 24 I/O capacitive-touch enabled pins. It is also a 10-bit ADC. It consumes low power, low voltage supply, low cost, flexible in terms of peripheral modules and extended battery life. The functional block diagram of MSP430G2553 is shown in figure 1.

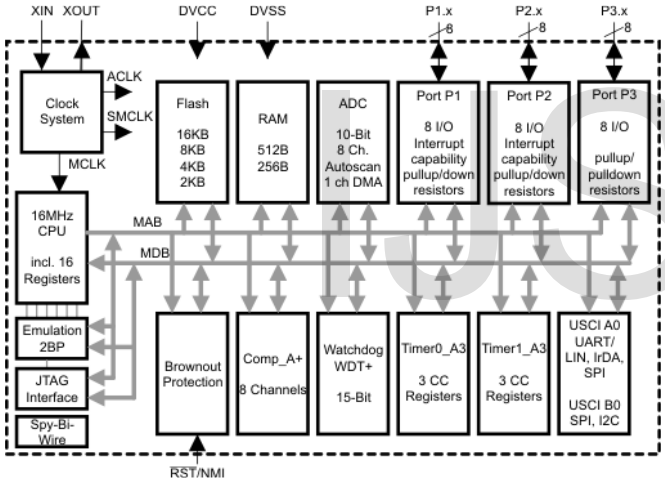

Figure.1. Functional block diagram of MSP430G2553 microcontroller.

2.2 GSM and Vibration Sensor Module

GSM Module showcased in Figure 2. This module is a reliable as well as compact. The SIM900A is a finished Dual□band GSM/GPRS arrangement in a SMT module which can be implanted in the client applications. Featuring an industry□standard interface, The SIM900A as an industry standard interface delivers GSM/GPRS 900/1800MHz execution for short message service, audio, Fax, and Data with less power utilization and in a little form factor. SIM900A can fit in practically all the space necessities in client applications as it has small dimensions of 24mm x 24mm x 3mm.

Figure 3 shows the vibration Sensor Module.

This module consists of comparator LM393 and vibration sensor SW-420 which detect signal to compared it with threshold value. Vibration is detected if the signal value is greater than threshold value. Onboard potentiometer is used to adjust the threshold value. In the absence of vibration, the output of module is at Logic Low which can be indicated by LED Light. The green light of LED indicated the Logic low output and module switch is at closed state i.e., there is no vibration. In the presence of vibration, the output of module is driven to Logic High i.e., vibration switch is in open state and LED light does not shine. The output of this module is con

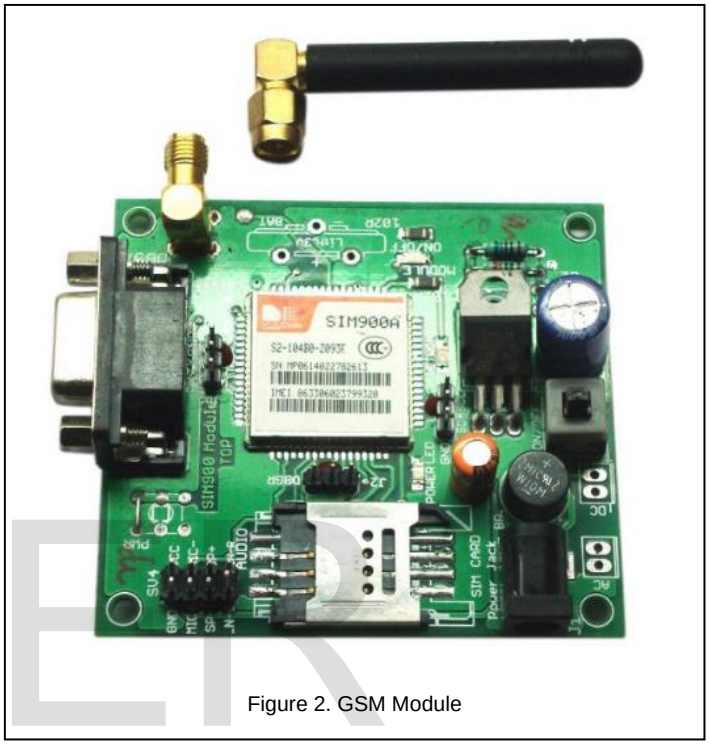

Figure 2. GSM Module

nected with the microcontroller to detect the presence of vibration and use it as an alarm.

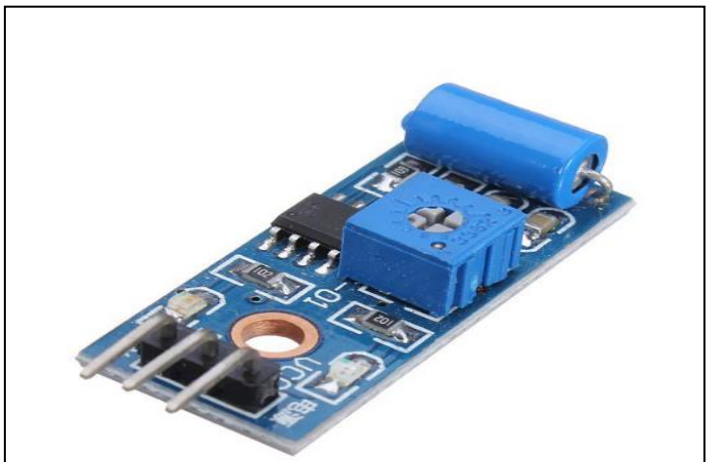

Figure 3. Vibration Sensor Module

2.3 Database Management Software — MySQL

MySQL [8] is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language.

A database management structure is constructed using MySQL for all the end users. Here, two tables have been constructed using MySQL. The first table consists of the details of all the customers using the accident detection system to sense the accident. The details comprise the customer ID, name, contact number, address, blood group of the customer. It also consists of car insurance status.

The other table has the details of only those customers who are injured and have faced the accident. It consists of accident ID, customer ID which is the issued number from the table 1, latitude and longitude of the location, time and date of the accident and emergency contact and name of the go to person of the victim. Hence, the database of the users experiencing a road accident is managed, with coordinates of location that enables the Google maps API.

3 Proposed Work and Methodology

3.1 Vehicle Tracking and Accident Detection System

The vehicle tracking and accident detection system circuit is shown in figure 4.The vibration sensor, GPS module, GSM module are connected to the MSP430G2553 MCU and used for subsequent programming and implementation. The vibration sensor module is used to interface and sense vibration of collision during the accident.

The location of the vehicle in the crash, with the device installed, is pinpointed using a GPS module, that provides with the latitude and longitude, constituting the coordinates. In a weak signal environment, choice of good antenna plays an important role in the excellent reception of GPS signal. [9]. Proper antenna choice and its placement will ensure that satellites can be seen at all elevations that results in accurate fix measurements.[10] Then, GSM module, with the help of a SIM (Subscriber Identification Module) card, sends a text message to all the aforementioned recipients by the end user, warning them about the accident and providing a Google maps link of the location at which the crash occurred.

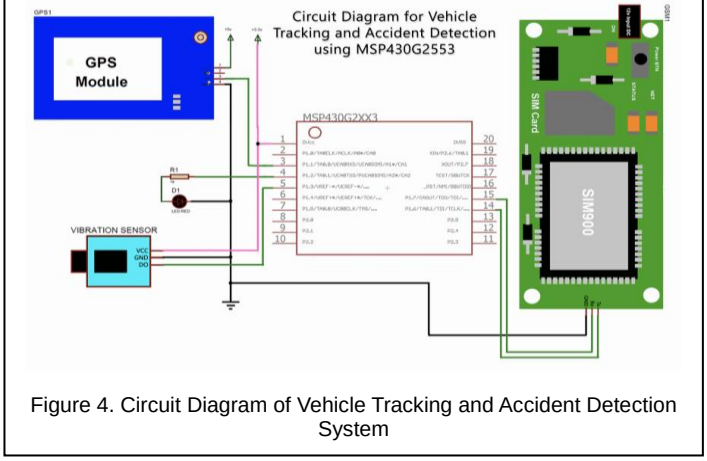

Figure 4. Circuit Diagram of Vehicle Tracking and Accident Detection System

MSP430, when turned on, showcases the ON state when the LED connected is lit up. The vibration sensor module detects any form of disturbance above a certain threshold, that can be categorized as a vibration. False or small vibrations are neglected. When the vibration is detected, the in-built LED on the Launchpad, which is on first pin, P1.0, glows to showcase detection. The GPS module pinpoints the location, and with required processing and handling of the signal via the code, is transferred to the GSM module. This module proceeds to send the text message to the mobile phone, based on the mobile number(s) entered in the code, and includes a google maps link generated using the GPS module in the form of coordinates within the link respectively.

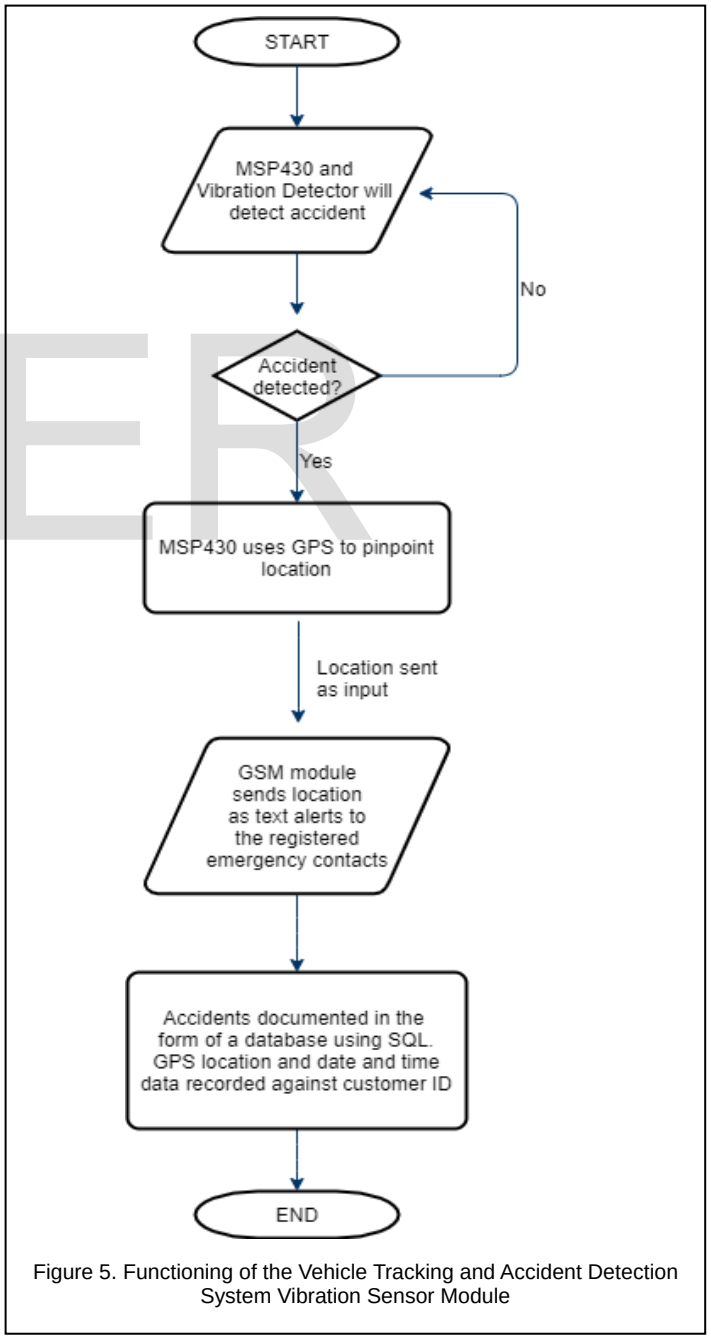

Figure 5. Functioning of the Vehicle Tracking and Accident Detection System Vibration Sensor Module

3.2 Vehicle Tracking and Accident Detection System

The Vehicle Tracking and Accident Detection System uses MSP430 board enabling the detection of the accident, pin-pointing the location, and subsequently documenting as well as alerting the customers' emergency contacts, be it their friends, relatives, hospitals and so on about the same.

The flowchart shown in Figure 5 showcases the step-by-step functionality of the ensemble respectively.

4 Result and Analysis

The results of proposed work are divided into two sections. First section comprises hardware and second contains MySQLsoftware results.

4.1 Vehicle Tracking and Accident Detection System

It can be showcased with the three figures which include.

a) Hardware Circuitry, Figure 6,
b) Text messages received from the GSM module, Figure 7,
c) Google Maps link, when browsed, Figure 8.

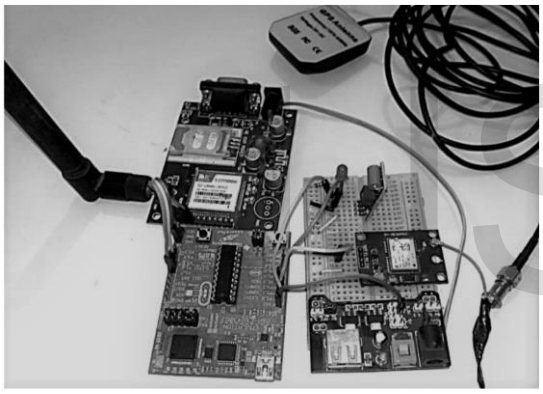

Figure 6. Hardware Circuitry

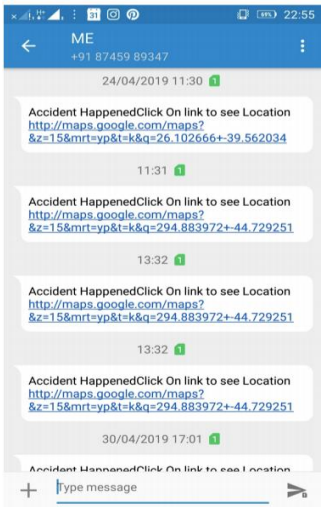

Figure 7. Text messages received from GSM module.

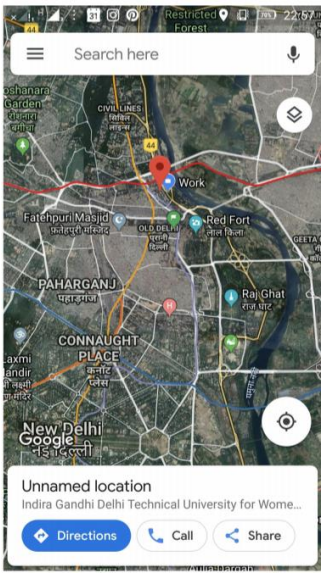

Figure 7. Google Maps link, when browsed on mobile phone

4.2 MySQL Results

Table I shows the customers and their details who get the accident detection system installed in their vehicles whereas Table II shows details of the victim.

TABLE 1
CUSTOMERS WITH THEIR DATA

```
mysql> select * from customers ;
+--------+---------------+------------+-----------------------------------------------+--------+----------+
| custID | Name          | Contact    | Address                                       | CarIns | BloodGrp |
+--------+---------------+------------+-----------------------------------------------+--------+----------+
|   2101 | Durgesh Singh | 9987238619 | 20/8, Block A, Saraswati Vihar                | Yes    | AB-      |
|   2102 | Aditi Singh   | 9937226710 | D/78, Sector-8, Dwarka                        | Yes    | O+       |
|   2103 | Niharika Sharma | 8798225510 | A8, Shaanti Apartments, Janakpuri           | No     | O+       |
|   2104 | Nidhi Chatterji | 9310100456 | 43, Kaveri Hostel, IGDTUW, KAshmere Gate    | Yes    | O+       |
|   2105 | Kishan Lal    | 9310456112 | 22/25, Rajouri Garden (Near Pillar 420)       | Yes    | B-       |
|   2106 | Saraswatichandra | 9876543210 | 20/C, DDA SFS Flats, Pirampura             | N/A    | B+       |
|   2107 | Atul Grover   | 7890123456 | 209C, Pushpanjali Apartments, Sector - 19, Noida | No  | A-       |
|   2108 | Kanan Rawat   | 9281758401 | 1091, CPS Apartments, Sector 9, Pocket 1, Rohini | Yes | O+       |
+--------+---------------+------------+-----------------------------------------------+--------+----------+
```

TABLE 2
ACCIDENT_DETECT W.R.T. CUSTOMERS' IDS

```
MySQL 8.0 Command Line Client
mysql> select * from customers ;
+--------+---------------+------------+-----------------------------------------------+--------+----------+
| custID | Name          | Contact    | Address                                       | CarIns | BloodGrp |
+--------+---------------+------------+-----------------------------------------------+--------+----------+
|   2101 | Durgesh Singh | 9987238619 | 20/8, Block A, Saraswati Vihar                | Yes    | AB-      |
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|   2108 | Kanan Rawat   | 9281758401 | 1091, CPS Apartments, Sector 9, Pocket 1, Rohini | Yes | O+       |
+--------+---------------+------------+-----------------------------------------------+--------+----------+
8 rows in set (0.00 sec)

mysql> select * from accident_detect;
+-------+------+------------+----------+-----------+---------------------+-----------------------------------+
| accID | c_ID | Contact    | Latitude | Longitude | DateTime            | Emergency_Contact_and_Name        |
+-------+------+------------+----------+-----------+---------------------+-----------------------------------+
|  1001 | 2105 | 9310456112 | 28.665300 | 77.232399 | 2019-04-24 11:30:36 | 986543201 (Amit Singh)            |
|  1002 | 2105 | 9310456112 | 28.665300 | 77.232399 | 2019-04-24 11:31:13 | 986543201 (Amit Singh)            |
|  1003 | 2105 | 9310456112 | 28.665300 | 77.232399 | 2019-04-24 13:32:56 | 986543201 (Amit Singh)            |
|  1004 | 2104 | 9310100456 | 28.699078 | 77.138710 | 2019-04-24 13:32:56 | 789540123 (Dhrishti Gupta)        |
|  1005 | 2105 | 9310456112 | 28.665300 | 77.232399 | 2019-04-30 17:01:22 | 986543201 (Amit Singh)            |
|  1006 | 2105 | 9310456112 | 28.621918 | 77.087868 | 2019-04-30 21:48:21 | 986543201 (Amit Singh)            |
|  1007 | 2106 | 9876543210 | 28.664785 | 77.232216 | 2019-05-01 11:49:13 | 8978675645 (Akshra Raj)           |
+-------+------+------------+----------+-----------+---------------------+-----------------------------------+
7 rows in set (0.00 sec)
mysql>
```

5 CONCLUSION

Texas Instruments' Low Power MCU, MSP430, is the perfect microcontroller for low power consumption, high speed and functional capabilities as well as low-cost solution to track and detect vehicles respectively, whereas, S. Mutharasu [11], Arduino Based Vehicle Accident Alert System using GPS, GSM and Accelerometer come with a disadvantage of high power mode. Thus, proposed work provides a huge advantage due to its low power modes, contributing towards the possibility of exploring the usage of MSP430's different levels of sleep modes until a specific event (interrupt) occurs for the device to restart (not the crash).

L Chan Zhan teal proposed a conventional method of detecting accidents with airbags and accelerometer as detecting sensors and then using GPS as location locator and then realising on GSM to send the notification of the accident. C.Thomson proposed a smart phone-based accident detection system in which by the built-in sensors of the Smartphone like accelerometer and compass an accident will be detected and then its notification will be sent. But the issue with the above-mentioned systems is their accuracy problem with their sensors which can give rise to false alarm conditions and do not detect all the accidents efficiently [12].

Moreover, SQL Server Management System provides an open source, or even a community platform for Relational Database Management System, or RDBMS, making it feasible for prototyping, management of tables and databases, and low-cost applications, respectively.

In conclusion, proposed Vehicle Tracking and Accident Detection framework provides a smart and efficient manner of detecting accidents, providing a methodology of detecting accidents in a manner that is only available in vehicles from luxury brands such as Volvo, or Mercedes, or Ford, etc. This gives the prototype the capacity to be easily utilized in a vehicle within any price range, operative and ready for service in a low-power and cost-effective approach respectively.

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