# Road Charecterization for Digital Maps

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***Abstract*-This study aims at solving the social problem of accidents due to unavoidable weather conditions and bad roads. This study will derive a system that is recursive and smart enough to read the inconsistency via accelerometer and analyze it. It has an interface of global positioning system to map the coordinates of the inconsistency and through the wireless channel transmit the same to an off board processor. Then the same is saved in a data base and vehicle is alerted about the forthcoming inconsistency. This system is flexible to learn about new inconsistency and erase the past ones if its existence is disproved with further trials. Thus being a recursive and independent of human interface it is novel system with minimum maintenance.**

***Keywords—Inconsistency, accelerometer, database, wireless communication, haversine’***

## I. INTRODUCTION

This paper is to implement a novel system to detect, maintain and warn the forthcoming road inconsistencies. In hilly, fog affected and unmaintained areas, vehicles/ motorists are more prone to accidents which have been proved to be fatal in the past. There is insufficient knowledge about the location and type of these inconsistencies as well [1],[2]. Hence, this system provides a two-step solution by eventually warning the motorist about the inconsistency. This is also a self-learning and recursive system which requires less human involvement. The availability of the technologies in the present automobiles is sufficient to create a warning system. But the integration of these technologies inspired the paper to develop the system.

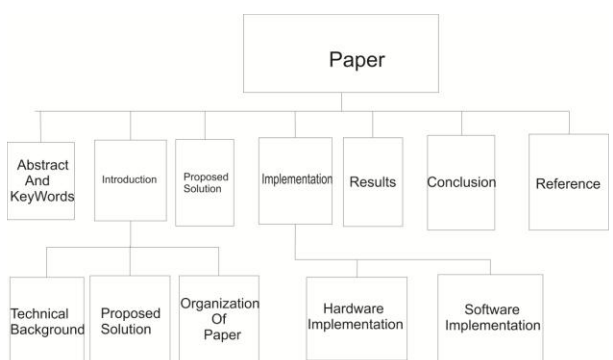


**Figure 1: Structure of your paper**

### *A. Technical Background*

There are many proposals to use smart mobile systems to analyze and warn about the inconsistencies. But, the inefficiency with respect to aligning the system and human involvement falls short in comparison with this study. These studies have also approached at integrating wireless communications and the sensors with respect to the automobile to analyze its kinematics, location and altitude[ 3],

### *B. Proposed Solution*

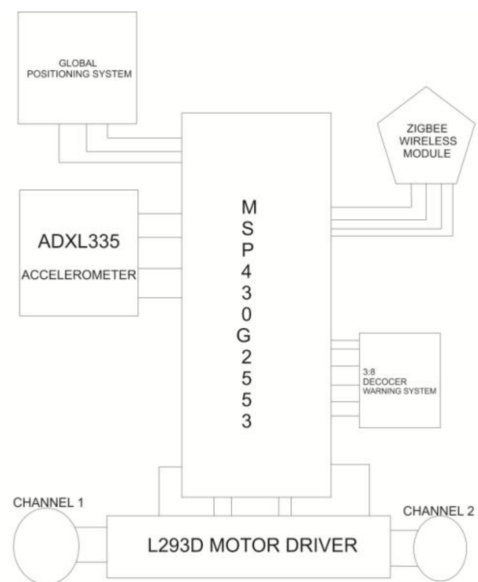


**Figure 2: Design of Vehicle**

The system designed has inputs from the accelerometer and the GPS module. It gives the outputs to the motor driver and the decoder circuit. It wirelessly communicates with the off board system [4]. The database is stored in this off board system. Hence, the proposed system provides a solution to help avoid the road accidents. In comparison with other studies, the paper provides a recursive loop with simple components easily implementable and feasible in vehicles.

### *C. Organization of the Paper*

The paper starts with the abstract which gives an overview of the problem statement and system. It is followed by the introduction which is subdivided into the Technical Background, Proposed Solution. Next, the proposed solution is explained in detail. This is followed with the Implementation, both Hardware and Software. The paper then highlights its results and is concluded. The acknowledgement and references follow them.

## II. PROPOSED SOLUTION

The solution of the paper aims to help solve the road accidents caused due to bad road conditions and unavoidable visibility of the road due to weather conditions such as fog. The paper assumes that the vehicle will have a GPS point fixed. The on-board and off board ZigBee devices used in the prototype are in able to communicate in their well-defined range [5]. The prototype is also subjected to the inconsistencies which are in scale to the prototype size [6],[7].

## III IMPLEMENTATION

### *A. Hardware Implementation*

The paper uses the TI's MSP430G2553IN20. This microcontroller was ideal for our design as it enabled low power consumption and easy interface with 3.3V logic level, as most of the system components were at the same logic level. The TI's L293D motor driver IC is used as it provides a highly accurate control of the motors. A 5V output from TI's LM7805 regulator had to be brought down to 3.3V using the TI's LM3940 regulator which powers the microcontroller.

The controller is provided with the interface of ADXL335 accelerometer with $\pm$3g of sensitivity. The accelerometer is pre-calibrated considering the abruptness of the inconsistencies. Then as the vehicle crosses the inconsistency it is received and analyzed and then the type of inconsistency is decided. The paper also uses the TI's SN74LS137 3:8 decoder. There were a total of five LED warnings and an output to disable all the LEDs for no inconsistency warning. Hence with the requirement of six outputs this IC was ideal. The ZigBee devices were used only for the proof of concept of wireless communication with the vehicle and off-board database storage system.

The off-board system is a Beaglebone Black. The reason for choosing this was to store data of several inconsistencies. Though the prototype uses only a single vehicle, several vehicles can be added to realize a more practical on-road condition. For this a very superior system with an ability to store large databases of inconsistencies is required. A simple microcontroller will not suffice.

### *B. Software Implementation*

The system uses two software codes, one for the MSP430 and the other for the BeagleBone Black:
The code at the MSP430 on-board can be summarized as follows by the pseudo code

1. Scan for input data in hardware UART
2. If 'R' is received // $GPRMC string is of interest and is scanned
3. Store GPS data in a string till longitude direction
4. Read analog values of tilt switch data along X and Y direction
5. Set parameters accordingly for hump, pit, roads curved left, roads curved right and elevation.
6. Represent each inconsistency with a character
7. Send GPS string and inconsistency character to software UART serial pins connected to ZigBee
8. Receive the motor control and warning characters serially through ZigBee // Control of motors is through switches attached to BeagleBone Black
9. Call motor control function for controlling motors
10. Call warning LEDs function for input to decoder address pins

The code at the off-board BeagleBone Black can be summarized as follows by the pseudo code.

1. Read state of switches connected to the GPIO pins
2. Send motor control character serially to UART 1 of P9 header
3. Read input data through UART1 // Contains GPS string and inconsistency character
4. Proceed if 'A' is in $GPRMC string // 'A' is valid data, 'V' is navigation warning
5. Extract latitude and its direction, longitude and its direction
6. Convert from standard format of lat and lon to radians
7. Find database which is nearest to the current lat and lon of vehicle using distance calculation
8. If distance is greater than safe limit, then store as a new database
9. Else, find the inconsistency of the database
10. Transmit wirelessly as a warning character

## IV. RESULTS

The vehicle is over a hump and the character 'h' is sent to the off-board wirelessly along with the GPS co-ordinates.

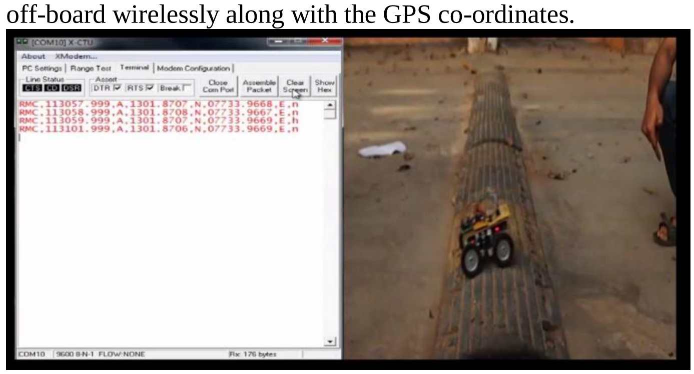

**Figure 3: Vehicle Testing**

The similar method was adopted to record other inconsistencies at various locations. The results are inaccurate with respect to the GPS readings.

## V. CONCLUSIONS

The paper was supposed to warn the vehicle well advanced to the inconsistency. But due to the GPS inaccuracy, this was not achieved. This provides further scope of study to implement with a portable and better GPS.

However, to the extent of a proof of concept, it was successful and implementable at its small scale.


## ACKNOWLEDGMENTS

The authors would like to thank its institution M.S.Ramaiah Institute of Technology. We have got immense technical advices from the seniors, Nischal K.N and Anil Kumar. The video making would not have been possible unless Marut Pattanaik and Abhishek Singh had put their time in helping us out.


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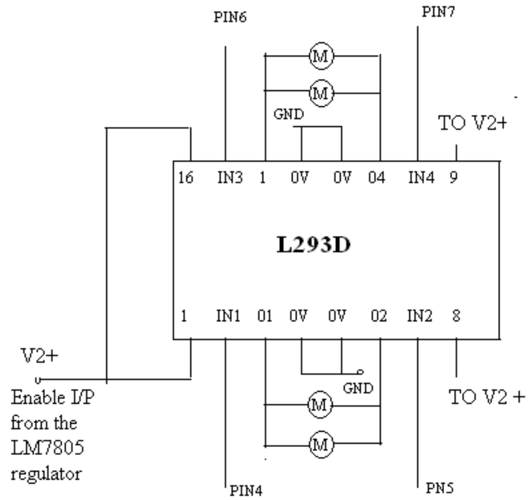
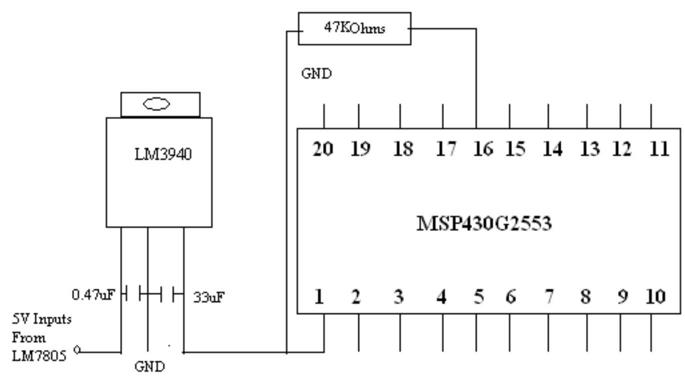
## APPENDIX A

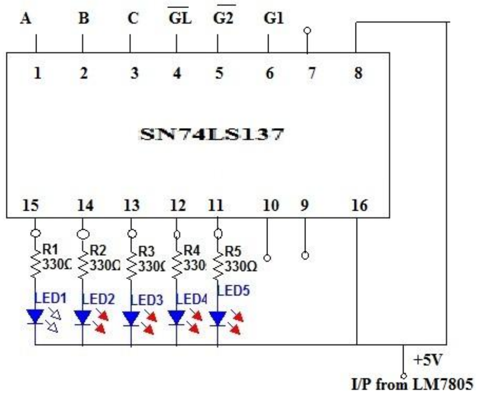
L293D motor Driver circuit




MSP430 controller board with 3.3V regulator




Decoder circuit




## APPENDIX B – BILL OF MATERIALS

Give a table which shows the name of the hardware/software component, number of components in the project, cost per component, whether the component is a TI/non-TI component, total cost of the component, and the total cost of all components.

| | Component | Manufacturer | Cost per component (in INR) | Quantity | Total cost of component | TI Supplied/ Purchased |
|---|---|---|---|---|---|---|
| 1 | GPS module | Skytraq | 1100 | 1 | 1100 | Purchased |
| 2 | MSP430G2553 IC | TI | - | 1 | - | TI Supplied |
| 3 | L293D | TI | - | 1 | - | TI Supplied |
| 4 | SN74LS137 | TI | - | 1 | - | TI Supplied |
| 5 | ZigBee module | Melange Systems | 850 | 2 | 1700 | Purchased |
| 6 | BeagleBone Black | TI | - | 1 | - | TI Supplied |
| 7 | ADXL335 Accelerometer | NSK electronics | 300 | 1 | 300 | Purchased |
| | Total Cost of the Project | | | | **3100** | |