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# Passing the IOTised Parcel

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**ABSTRACT**

Now-a-days, road accidents are the biggest cause of loss of life. So what if we will make the highways smarter itself? So, the objective of this work is to propose the design and deployment of sensors on as an embedded unit called as "IOTised Parcel" using the Internet of Things (IoT) so to make highways smarter. The main contribution of this work is the development of on-board unit which will have GPS-GPRS, Wi-Fi, Buzzer, LED, Accelerometer sensor, PIR sensors for the smart highways. The product is recyclable and can be used by skilled and unskilled drivers too.

***Index Terms:*** Smart highways, IoTised parcel, Sensors, embedded unit.

## 1. INTRODUCTION

Currently the trend is focused on making Smart city [1], Smart village, Smart vehicle but not on making Smart highways which is as crucial as Smart city, village. As hike in the number of accidents on the highways now-a-days are great concern for everybody here. We are losing our dear ones just because of the fatal accidents that could be avoided. The concept of smart highways can be implemented successfully using IOT and sensors. So, our project aims at reducing such accident by making the road transportation system smarter. The project includes giving a "IOTised PARCEL" (on –board units) on the toll gates to each vehicle passing through it and then that smart extravagant unit will help even the unskilled illiterate drivers to communicate with all other vehicles on that road. The term "IOTised" means it contain the sensors that will record information, creating open data sets, including: GPS-GPRS module, Wi-Fi module accelerometer sensor, Buzzer, PIR sensor and microcontroller like beagle bone black mounted on one single board which communicate to each and every vehicle up to certain limit.

## 2. LITERATURE REVIEW

Many studies have been conducted to implement the concept of IoT to make the cities, highways, villages smarter with the deployment of sensor network which generates large amount of data to be stored. Some of these are reviewed as under:

Reference [1] deploys sensors network in the GDL smart city where they have implemented various sensors on the road side unit to measure the level of pollution and intensity of light.

They have contributed their work towards the environment but they haven't put any focus on the human kind. The sensory data keep on growing so for that we can use NOSQL databases and this have been explained in reference [4]. There must be collaboration from the national authorities so that security on servers can be maintained. Reference [3] explained this concept of collaborating different authorities so

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that network can be distributed and it is fault tolerant. Reference [2] have implemented several protocol related Internet of thing that is Efficient XML Interchange (EXI), Constrained Application protocol (CoAP), 6LoWPAN which is suitable for constrained devices that is low power devices. Reference [5] deals with the communication vehicle to the road side units so that the vehicle is aware about the flood and all natural calamities with the help of accelerometer sensors, weather detection system and flood detection sensors. Reference [6] implements the architecture which introduces the use of an active radio-frequency identification (RFID), wireless sensor technologies, object ad-hoc networking, and Internet-based information systems in which tagged traffic objects can be automatically represented, tracked, and queried over a network. This research presents an overview of a framework distributed traffic simulation model within Net Logo, an agent- based environment, for IoT traffic monitoring system using mobile agent technology.

## 3. PROPOSED SYSTEM

### 3.1. System Description

We are designing an on- board unit which will have one buzzer when the speed is increased beyond a certain level, a WIFI Module which will sense the particular distance between the two vehicles and beeps a buzzer when the distance between the vehicle is too close, a GPS system which will help the server to know vehicles location, it will also help the expressway authorities to analyze the traffic by communicating with them via GPS & GPRS. The required component list is given in the Table 1. whole module will be operated at 5v with current requirement for beagle bone around 1-2A. When the speed between the two vehicles is increased beyond the threshold value, then the accelerometer sensor that is ADXL345 sense the hike in acceleration and send the data to the microcontroller which will further send the instruction to beagle bone for beeping the buzzer.

**Table 1**
**Component and Hardware list**

| *Sr. No* | *Hardware Component Name* | *Role* |
|---|---|---|
| 1 | Beagle bone black board (AMD3358-ARM CORTEX-A8) | Microcontroller |
| 2 | Edimax EW-7811Un | Wifi Module |
| 3 | Tracking Vayu Cape 3GHP-A | GPRS Module as well as GPS |
| 4 | ADXL345-EP | Accelerometer sensor |
| 5 | Piezo Buzzer PS1240 (PRODUCT ID: 160) | Buzzer |
| 6 | PIR (motion) sensor | PIR sensor |

### 3.2. Flow of project

We have planned to give such unit in the form of parcel to every vehicle which passes by the first toll gate and then taken away from the vehicle at the last toll gate.so this will help in recycling and reusing of the parcel. The flow of project is given in the Fig. 1.

### 3.3. Calculation

We can calculate the distance between two vehicles with the help of Wi-Fi signal strength. The formula is given as:

$$FSPL(db) = 20\log 10(d) + 20\log 10(f) + k$$

Where,

d = distance
f = frequency
K = constant that depends on the units used for d and f

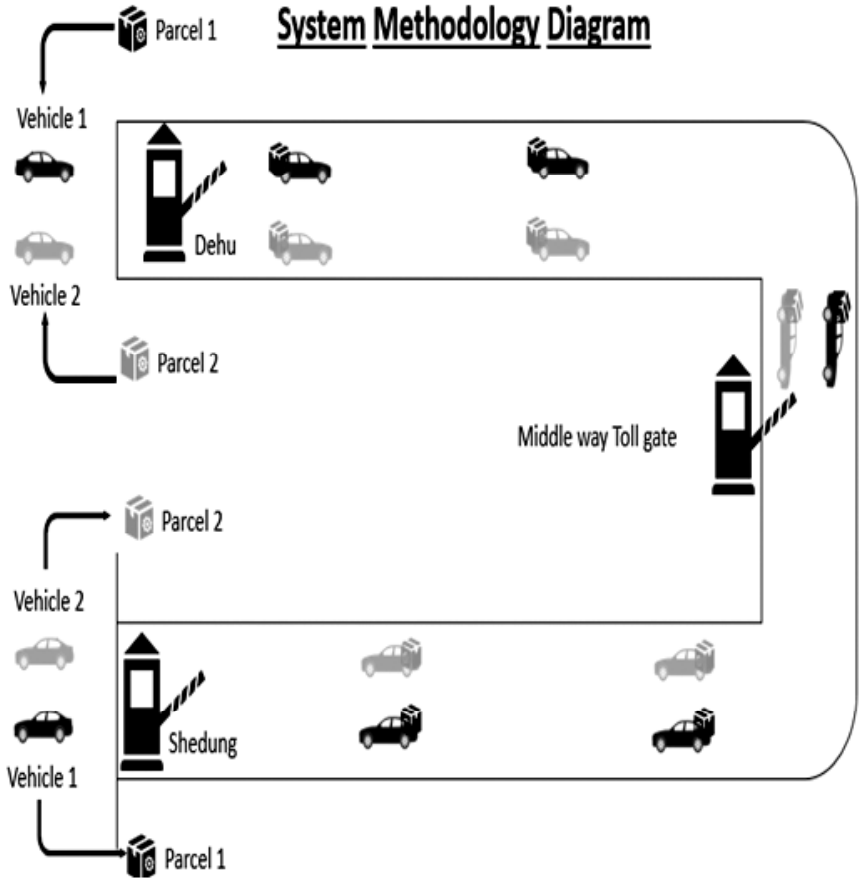


**Figure 1: Flow of Project**

If d is measured in kilometers, f in MHz, the formula is:

$$FSPL(db) = 20\log 10(d) + 20\log 10(f) + 32.44$$

### 3.4. Task dependencies in our model

The different task interacting in our system is given in Fig. 2.

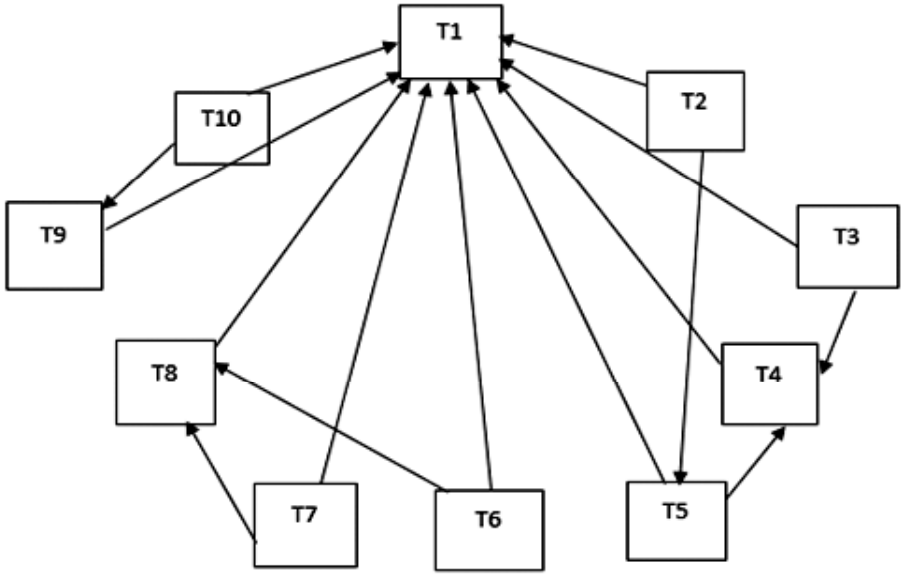


**Figure 2: Task dependency diagram**

Where, T1 = keeping parcel
T2 = Wi-Fi connection
T3 = acceleration increased
T4 = buzzer beeps
T5 = Distance between the two vehicles is too close
T6 = location tracking
T7 = traffic management
T8 = server connection
T9 = database creation and maintenance
T10 = data analysis

### 3.5. Mathematical Model

S = {s, e, x, y, Fm, Fs, DD, NDD, Success, Failure}

Where,

s = {Start state of program}
e = {End state of program}
x = {Input to given program}
= {user motion by accelerometer sensor}
y = {output to given program}
= {buzzer beeps}
Fme = {Main function in program}
= {main ()}
Fs = {Various functions performed in program}
= {initialization (), reset (), start (), stop (), cal_distance (), dataStore (), wifi (), GPS_GPRS ()}
DD = {Deterministic data}
NDD = {Goal state, current state}
Success = {Program run successfully}
Failure = {Syntax / Logical Error}

## 4. BLOCK DIAGRAM

The block diagram given in Fig. 3 consist of the BEAGLE BONE Black Board as the microcontroller. It also has GPS-GPRS, Wi-Fi module, Accelerometer sensor and PIR sensors. Beagle Bone Black is a low-cost. It has AMD335x 1GHz ARM Cortex-A8 processor. It has 512MB DDR3 RAM with 8-bit eMMC on-board flash storage. It also has 3D graphics accelerator and NEON floating-point accelerator. It also has 2x PRU 32-bit microcontrollers. This microcontroller has USB client for power & communications, USB host and Ethernet port. It also has HDMI port and 2x 46 pin headers. It supports Debian, Android, Ubuntu,

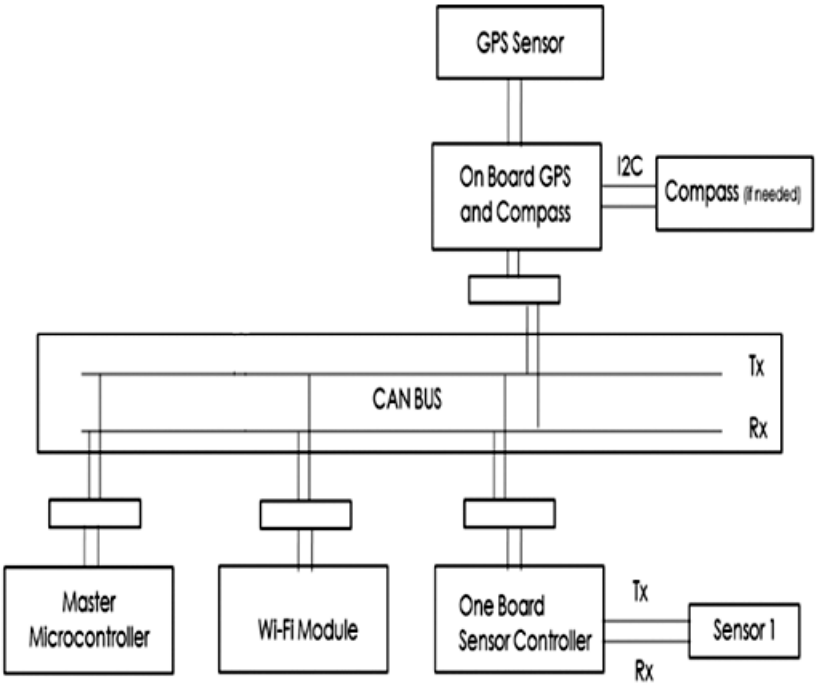


**Figure 3: Block Diagram**

Cloud9 IDE on Node.js w/ Bone Script library and many more OS. The accelerometer sensor is used to measure the speed. The dimension of the sensor is 20 mm x 20 mm. This is 3 axis accelerometer evaluation board. It has SPI (3- and 4-wire) and I2C digital interfaces. It has ability to survive 10,000g shock. The other one is PIR sensor which is used to detect motion is connected via GPIO pin of beagle bone The Detection distance is 3—7M can be adjusted. It has Infrared sensor with control circuit board.

## 5. PROTOTYPE DIAGRAM

We have used beagle bone board which is having two I2C where accelerometer and GPS-GPRS are interfaced as given in Fig. 4. Also GPS-GPRS are interfaced with the help of UART port on which RxD Receives the

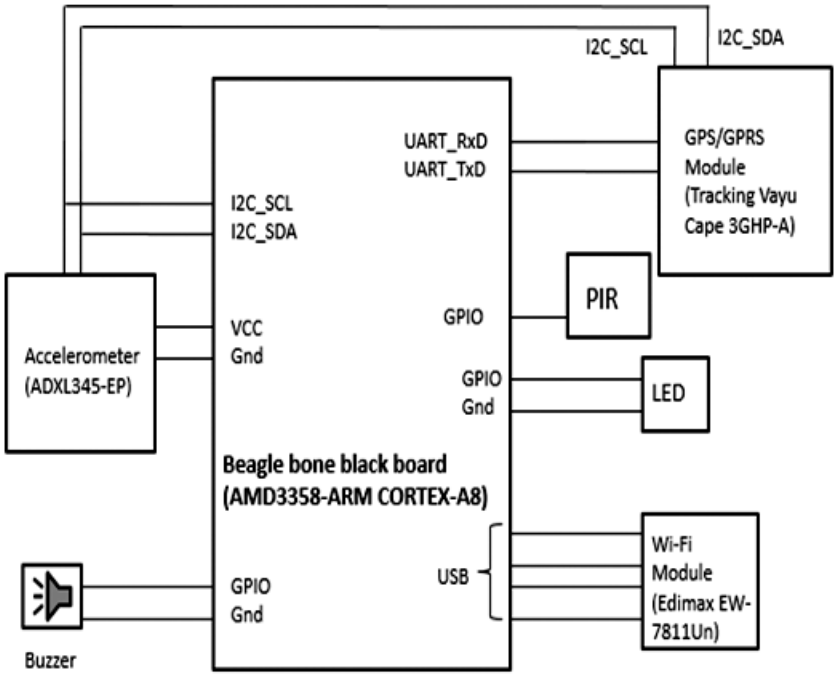


**Figure 4: Interfacing Diagram**

data and TxD transmits data. PIR sensor is connected to GPIO. Also we have interfaced LED and Buzzer via GPIO port. Wifi adapter is connected with the help of USB port. CAN (Controller area network) for the communication between different sensors and devices.

## 6. CONCLUSION

In this paper, we proposed idea for monitoring the accident over the highways, Excess speed, minimum distance between the vehicles can be calculated with different sensors. Also with the help of GPRS modem, message will be sent to the hospital, police station if accident happens, with the help of GPS we are able to find the location of the VEHICLE. It also helps in monitoring the traffic and prevents accidents. Our module is reusable too as it holds "GIVE and TAKE" Policy like the vehicle on the entrance tollgate will receive the module and will return the module while exiting from the highway. This module can be enforced into any vehicles. Also this module can be used by skilled and unskilled drivers. As per the analysis carried out by Indian Express, 14500 accidents took place from the year 2004 – 2016 within the distance of 94 km at the Mumbai-Pune Expressway among which most of the accidents were due to high speed of vehicles. So, as an outcome of this research, the accidents will be reduced by a major amount as well as the traffic will be monitored efficiently.

## 7. FUTURE SCOPE

With the advancement in embedded systems and distributed wireless sensors the scope of improvement in transportation system in our country is immense. Various improvements can be made to our current system. Firstly, we can implement NLUI (Natural Language User Interface) which will help in the improvisation of user interaction. User can communicate with the server side for querying. GUI can be implemented for further improvisation. We can use image processing to determine the driver's gestures, exact scenario where the driver is driving where further mining on image can be done for the further analysis. We can go for some highly improvised battery life like LiPo. Durability, compactness and overall design can be improved further.

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