International Journal of Engineering & Technology, 7 (4.20) (2018) 652-656

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Connected Cars and Smart Roads Using ARM and Wireless Sensor Network

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Abstract

Majority of the road accidents these days are caused due to driver slackness, bad road conditions and bad weather conditions. The ever growing death toll and lack of information to show up such emergences is being a great alarm. We propose a method of resolving the challenge described above by employing smart car communication technique along with a connected vehicle concept. An embedded processer along with a GPS receiver is incorporated into the connected car's dashboard to read the vehicle co-ordinates. Along with the GPS co-ordinates, the smart car also identifies for other objects in the road in its proximity and the movement of the car are controlled based the proximity sensors input. When a fatal accident happens in such case, an emergency alert using mobile message is sent to the nearest help line center along with the cars GPS co-ordinates.

Keywords: *Smart cars, connected roads, ARM, ZigBee .GSM Module*

1. Introduction

A connected car is a car that is prepared with wireless access, and usually also with an intelligent network systems. This gives the vehicle to impart the subtleties of vehicle availability to different focuses both inside just as outside the vehicle. Regularly, the vehicle is additionally equipped with unmistakable advancements that hit into the web or remote LAN and give further aids to the driver. Examples include: automatic cautionary of accidents, announcement of speedy and security warnings. Most of the connected cars these days will have built-in tracking systems which will guide and update the driver about speed limits of a certain road, driving guidelines from a given location etc.
The proposed system uses a SMS based mobile connected vehicle monitoring coordination using an integrated ARM server with Wireless Sensor Networks [1]. In this method, a ZigBee node is coupled to every sensor system which captures the data of various datas including vicinity of adjacent object, speed and RPM of the crankshaft etc. All these constraints are intermittently exchanged across two Zigbee nodes one connected to the centralized ARM server and the other connected to the microcontroller unit attached to different sensors. The data composed from the Zigbee node [2] is managed by the centralized ARM server and is updated periodically for every 2 seconds. There will be a GSM modem connected to the other end of the centralized ARM server which for sending SMS alerts. Speed limits of different roads
are calculated and the same is flashed in the centralized ARM based server.

2. Overview of the system

To build an autonomous system that controls the speed of an automobile based on the dynamic parameters like road speed, nearest object distance etc. In the proposed system, the speed and vicinity of the nearest object distance is intermittently calculated using a microcontroller. The procured information is conveyed to a brought together ARM server utilizing Wireless Sensor Networks. A ZigBee hub is coupled to the inserted microcontroller that takes low power and is little in size. These slave hubs are explicitly intended for low power utilization, with insignificant circuit modules [3].
WPANs appear to be an ideal fit for this need. Upon system start up, the patient monitor scheme will constantly observe the GPS co-ordinates along with the nearby objects distance using a proximity sensor. All these determined components will be intermittently send to the incorporated server utilizing ZigBee hub designed as co-organizer. The incorporated ARM server will have a pre-customized calculation which will infer the speed of the crankshaft dependent on the decided street speed. The final calculated road speed is fed to the crankshaft which will finally control the automobiles speed. If the proximity sensor discovers an object in and around the vehicle, then it will automatically reduce the speed and the new calculated speed is sent to the centralized ARM server using the zigbee transceiver [4]. The new speed is fed to the crankshaft and this will automatically reduce the speed of the vehicle based on the nearest object proximity. If a road accident happens either due to uncontrolled speed or due to very close proximity of a nearby object, then a automated SMS will be sent to a pre-programmed mobile number.
The automated SMS will consist of 1. Vehicle registration number. 2. Details of the owner of the respective vehicle. 3. GPS co-ordinates of the vehicle. The mobile number will usually be the emergency service number for ambulance and the relative of the vehicle owner. Along with the automated SMS, an alarm will be triggered by the system which will alert the public near the area where incident took place. In case of emergencies the vehicle location and GPS co-ordinates is sent in the SMS. The automated reply for the SMS will be sent by the centralized ARM server which includes the location of the vehicle, GPS co-ordinates, current speed etc.

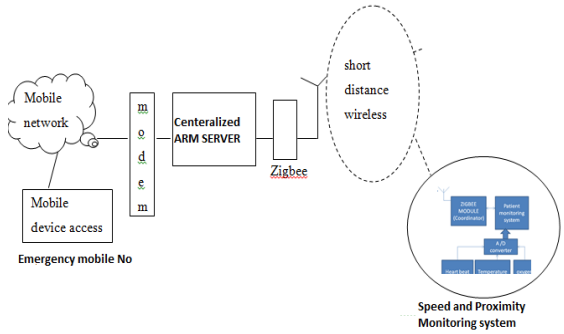

Fig:1: Overview of system

In this paper, a system is introduced to avoid collision based on the vehicle to vehicle communication with some driver behaviour by using a car following model based on risk perception. Mainly the rear end collision avoidance system detects the risk situation based on the information collected by the radar and camera. The system will give a warring to the driver that the speed is not safe and it is on a risk situation and helps the driver to brake. Car-following model is one of the most important gist for avoiding rear-end collisions system by connected vehicles the data obtains by subsystem includes speed, acceleration, heading position and other information collected by the on-board sensor. GPS collects the information of position, speed and heading and the TP-link or Denso shares and receive the message of motion data, EVB can reduce the vehicle's speed, the screen and loudspeaker give the warning of danger to drivers. After getting the information, the research should be focused on the way to avoid the collision, first step of avoiding rear-end collision, target recognition is the foundation of the danger identification.

3. System architecture

The entire system consist of three modules a) Vehicle section b) Road section c) Car section. The connected road system consist all these 3 units to coordinate and communicate with each other to transfer the information in to the network gateway. The vehicle section consists of sensors to monitor whether the vehicle as got an accident and the location of the accident. The vehicle system also got sensors to detect the health condition of the driver. On any sudden accident and abnormal conditions, the information's about the vehicle and driver is sent to concerned doctor and the relatives of the vehicle owners.

The hardware model of Wireless Sensor Network Gateway is based on ARM controller. With the aid of ZigBee and GSM units, the module can gather the information about accident and location and is been communicated to the concerned persons. In this the Zigbee hub is interfaced to focus essential ARM processor in which the sensors are associated.

The GSM interfaced through which instant messages in type of SMS cautions are sent to the specialist's telephone number [5]. A lot of designed AT directions are expected to figure a SMS and send it to the arranged telephone number which is fixed utilizing a program for the GSM hub. The model is made usable so that the SMS alert number can be updated during the system start up time [6]. The model of the proposed system is shown in figure 2.The second unit is a Road section module, which receives the information from the vehicle section and broadcasts the data to the upcoming vehicles on the route and also transmits to the other persons. This road side module has a solar panel for self-powering. This module act as a mediator to couple the datat to the nearest vehicle travelling..

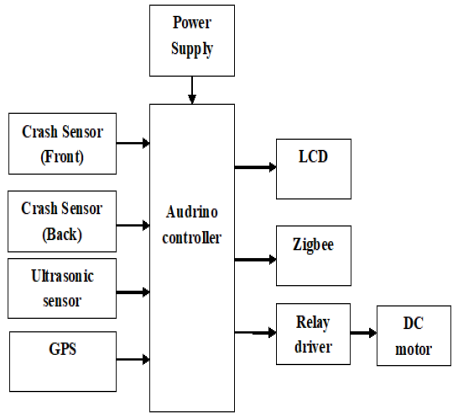

Fig:2: Vehicle Section

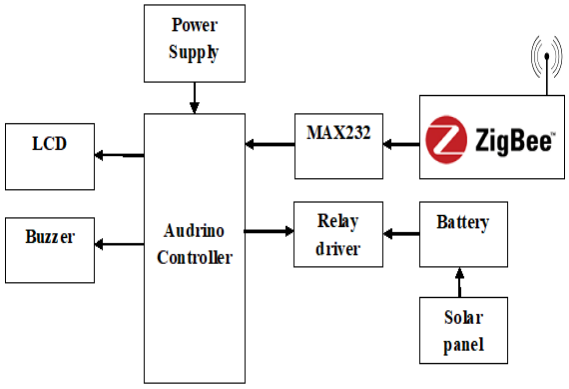

Fig:3: Road Section

The second car section which is travelling nearby can hold the data for understanding the condition of the vehicle which is going in ahead. The condition of the vehicle and the driver is reported to the next vehicle or the doctors

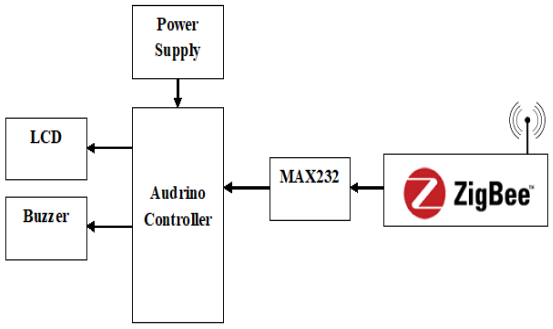

Fig 4: Following Car Section

3.1 Proximity Sensor

A proximity sensor is a device capable to sense the occurrence of a proximate objects without any direct contact. A proximity sensor frequently radiates an electromagnetic field or a ray of electromagnetic radiation (infrared, for instance), and sees for variations in the field or arrival signal. The object presence detected is often stated to as the proximity sensor's objective. Different proximity sensor objectives demand various sensors

3.3. Zigbee Module

Tarang wireless device are low to medium-power devices and seemly for including wireless ability to any product with serial data connect. The components needed limited power and gives dependable transfer of data between devices. The I/O interfaces

gives with the Module help to straightforwardly associate with any standard sequential gadgets. ZigBee utilizes both of two modes, reference point or non-guide to empower the back and forth information traffic. Signal mode is utilized when the organizer keeps running on batteries and in this way offers most extreme power funds, while the non-reference point mode discovers support when the facilitator is mains-fueled.
In the signal mode, a gadget keeps an eye out for the facilitator's reference point that gets transmitted at occasionally, bolts on and searches for messages routed to it. In the event that message transmission is finished, the facilitator manages a timetable for the following reference point so the gadget 'rests'; truth be told, the organizer itself changes to rest mode.
While utilizing the guide mode, every one of the gadgets in a work organize realize when to speak with one another. In this mode, fundamentally, the planning circuits must be very precise, or wake up sooner to make sure not to miss the signal. This thus implies an expansion in power utilization by the facilitator's collector, involving an ideal increment in expenses. The non-guide mode will be incorporated into a framework where gadgets are 'snoozing' almost dependably, as in smoke indicators and robber alerts. The gadgets wake up and affirm their proceeded with nearness in the system indiscriminately interims.
On identification of movement, the sensors 'spring to consideration', in a manner of speaking, and transmit to the regularly holding up organizer's beneficiary (since it is mains-fueled). In any case, there is the remotest of chances that a sensor finds the channel occupied, in which case the beneficiary shockingly would 'miss a call'.

4. Software Model

The application software architecture of the system consists of 3 major modules [7].

1. GSM module for communication of the ARM server with the outdoor world.
2. ZigBee module for communication of the sensor data connected to the server location monitor system
3. Proximity and position monitoring system for processing the vehicles information and maintaining a log file.

Upon framework start up, the nearness screen framework will ceaselessly screen the vehicles parameters like speed, area and Proximity of the close by article and will intermittently send those parameters to a brought together server utilizing ZigBee hub designed as co-organizer alongside the driver data.
The data will be gotten by a unified server (ARM) to which a ZigBee hub is associated in an ASCII string group. The got information from the region checking framework is broke down and the principal parameter of the string is gathered which are the GPS co-ordinates. The staying of the imperatives incorporates the essential parameters like nearness, speed and so forth. Every one of these parameters are at first signed in a standard log position in a document in JFFS record group which is the piece of blaze document framework and afterward prepared as needs be. Each log message comprises of an autos data alongside the time stamp of the message got pursued by the specific patient's parameters (like Heart Beat/Temperate Etc)
A lot of arranged AT directions are required to set up a SMS and send it to the designed versatile number which is executed utilized a program for the GSM module. The ARM server persistently gets the required information utilizing GSM Module and it likewise enlists. This ARM processor goes about as the door to zigbee and GSM module. ARM is associated with GSM module through which instant messages like SMS cautions are sent to the pre-arranged versatile number which is configurable amid the framework bootup [8].

4.1. Device Driver Program

The Zigbee module interfaces with the ARM server using a serial device driver program and on the other side the GSM module connects with the ARM server using a USB Device module. Both the sequential and the USB gadget drivers are given of course as a piece of standard Linux Kernel that is implanted inside the ARM framework.
A typical JFFS file system provision is resulting for event logging and error logging through the system's process. To support this process, JFFS file support is allowed as a compile preference through the Linux Kernel accomplishment.

4.2. Serial Exchange Protocol

A trademarked Serial Exchange Protocol (SEP) is considered and recognized for data release between the wireless patient monitoring system and the centralized ARM server. The information traded among the brought together ARM and the server will be of a string design containing separate crucial patient parameters like heart beat and so on isolated by a delimiter. The common organization a SEP includes character string followed by connected parameter esteem separated by delimiter.

4.3. High Level Design

There are two main programs in the project

- The GSM logic will be in main.c
- The monitoring system logic will be in ARM Monitor. c

The GSM structure will be in GSMfrmwrk_v5.c.sms_gsm.h will have macros and game plans identified with GSM system. Understanding Monitoring framework will have rationale identified with brought together ARM server. This document contains rationale for coordinated effort with ARM screen gadget over Zigbee. A content based parser is connected in this record which will parse the content string and will store the parameters dependent on certain patient in a structure.
Each opportunity a message originates from zigbee interface the rationale inside ARM Monitor. c will get the information that will be handled further. SMS messages from the ARM Monitor. c record will be sent to the GSM procedure utilizing a message Queue. At whatever point a message originates from the GSM structure like specialist's solicitation a message will be dispatched by gsmfrmwrk_v5.c utilizing another message line. The ARM monitor will hang tight for such a message utilizing P-Thread. Thus the ARM monitor will sit tight for extra message from zigbee interface [10].

There will be four strings progressively inside each procedure
1.SerialRXTask will save the information over sequential interface and will put the message in a message line.
2.SerialTxTask drives a message over sequential interface which it has over a message queue.serialRxQueue.
3.The last two strings mQZbTxTask and mQZbRxTask will process the message got from the serialRxTask string serialTxTask and will follow up on the message (like sending SMS alert/setting off the caution) in light of the program.

4.4. Steps for linking target and the host assembly

- As we don't have an advancement situation like compiler and manager inside the objective pack as a result of asset limitations like less CPU recurrence and less RAM and ROM we will build up our program on a host machine and duplicate it to the objective utilizing a system (LAN).
- Once after effective copy we will perform the program in the similar way as host system.
- To copy the file from host to target over LAN we use a file transfer protocol called TFTP(Trivial File Transfer Protocol).

- We use LAN based file copy because that is one of the very standard method and most of the embedded kits these days comes with a default LAN port(interface) nothing but ethernet interface
- Development kits like friendly ARM comes with one default serial interface which is used to interact with the kit.
- A invalid modem is utilized for association between the unit and the host framework.
- The Ethernet link is utilized for correspondence between the host and the objective for record exchange while the invalid modem is utilized for communication with the unit and the developer.
- TCP/IP convention suit (TCP/UDP/IP) keeps running on both the objective unit and the host framework. We can associate a LAN link utilizing - Ethernet interface for information exchange.
- RS232 convention is utilized for sequential correspondence.

4.5. Steps for interaction with the kit

On the off chance that a developer needs to exchange with the unit, at that point he will run a terminal emulator programming on a host gadget. The terminal emulator will inside use RS 232 convention for correspondence. Programming advancement stage is Linux 2.6.32 and the Cross-compiler condition is arm-linux-gcc-4.4.3. Projects configuration mostly incorporates two sections, one is gadget driver program, and another is application program. Driver program keeps running in the bit space and it is the inside which is called by the application program to accomplish the assignment of framework.

5. Results and discussions

The coordinated screen framework is first associated with a Zigbee co-ordinator utilizing a TTL Interface. After catalyst the present patient screen framework utilizes a clock program which keeps running on an ATMEL based microcontroller alongside the associated interfaces given underneath.

1. **Proximity Sensor**
2. **GPS Sensor**
3. **Speed Sensor.**
4. **ZigBee Transceiver**
5. **Interfacing of the GSM and Centralized ARM Server Module**
6. **Connecting of the vehicle monitor and Zigbee**

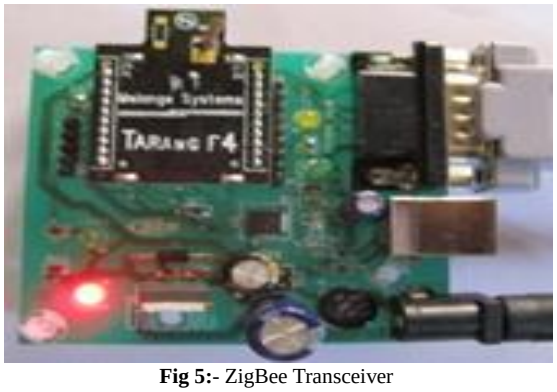

Fig 5:- ZigBee Transceiver

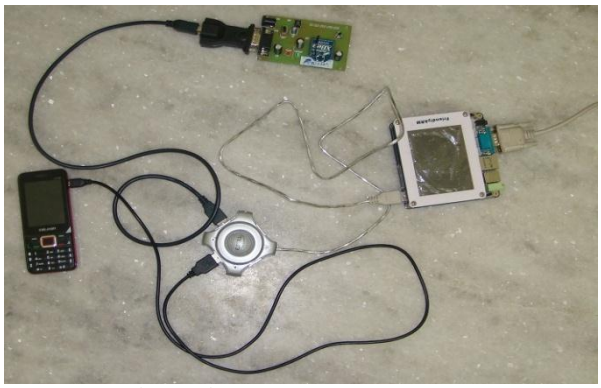

Fig 6: Interfacing of the GSM and Centralized ARM Module

The clock program will follow for at regular intervals and will be occasionally aggregate the information from a specific patient. When the clock ends, this framework readies a messages which includes the patients significant information and is sent over the air utilizing the zigbee co-ordinator unit. A test setup is created with a patient screen framework coordinating the patients data intermittently for each 10 sec's. The information transported by the framework is dealt with utilizing the incorporated ARM server and at whatever point a specific patients Heartbeat or temperature dribbles underneath a specific limit a robotized SMS is sent to the arranged portable number.

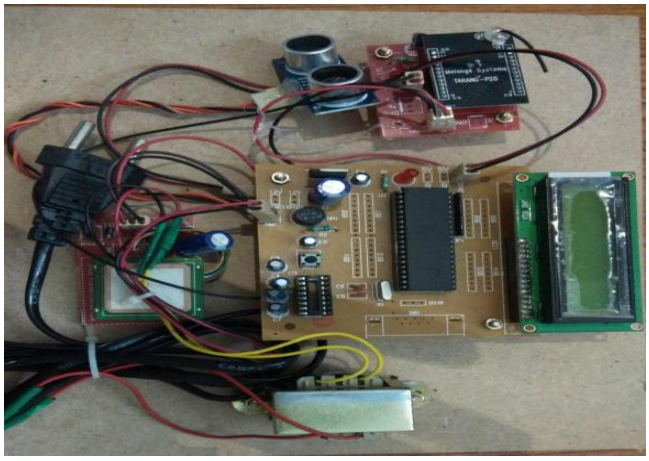

Fig:7: Interfacing of the vehicile monitor and Zigbee

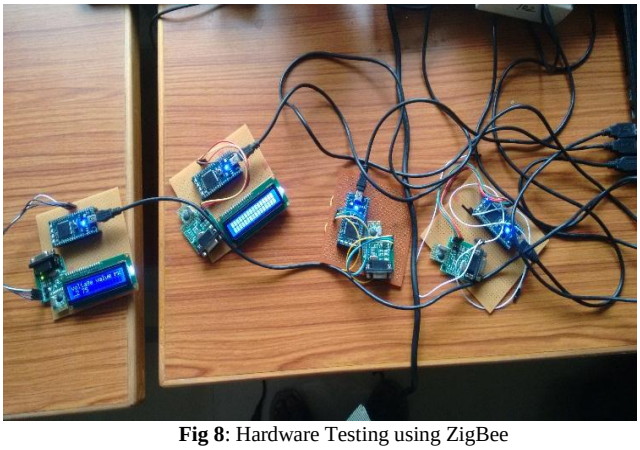

Fig 8: Hardware Testing using ZigBee

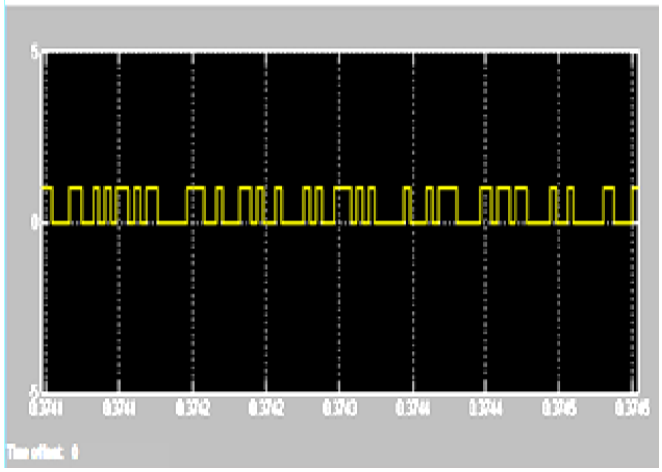

Fig 9: Input to the ZigBee transmitter

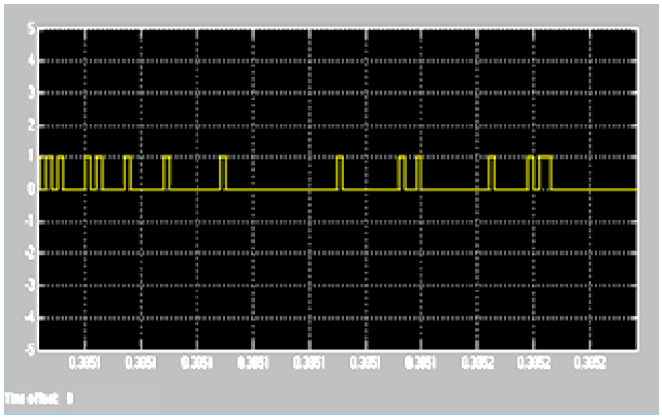

Fig 10:. Output at ZigBee receiver

The above examination is performed with four distinct vehicles with various ready parameters and is appeared in figures 6, 7, 8, and 9. A message from a legitimate portable number is sent to the ARM server mentioning for a record of a specific vehicle no, and the reaction of the message contained the mentioned data like speed/GPS co-ordinates and nearness.

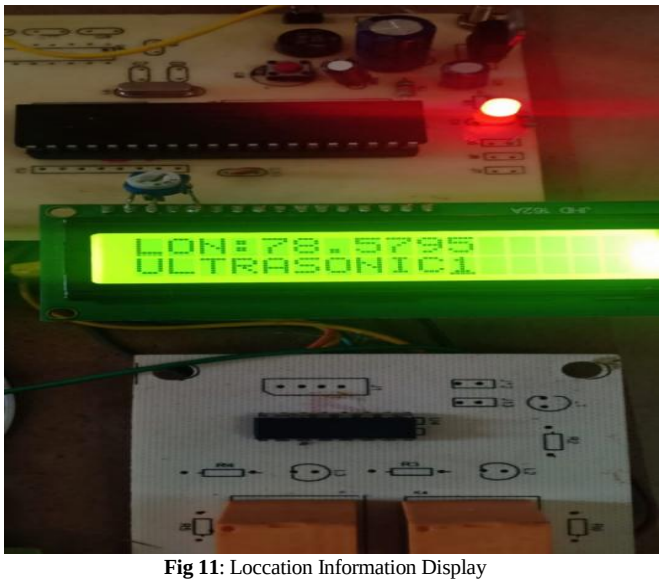

Fig 11: Loccation Information Display

6. Conclusions

The present system can support real time parameters like GPS/Proximity/speed etc with real-time, low-power, low-cost, long-distance, and dual-mode monitoring. The use of ZigBee Tarang modules communications processor has the assistances of intelligence, compact size and dependability. By the support of this integrated chips, external components and hence wirings are kept to a minimum. A reliable networks (WPANs) has been presented and described, and also a compact software implementation method has been used to develop this smart road system. The system established supports to offer information about the patients wounded due to accidents for providing initial treatment aids before bringing them to hospitals. Further advantage of this system is its low-power consumption, which is smart for portable applications.

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