Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 04, April-2021

A Novel Approach in Road Safety using IoT Node Mesh

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***Abstract*—In this paper we present a novel approach to reduce road accidents and improve road safety on highways. This project based on IoT mesh technology. There are several nodes installed on roadsides (roughly one thousand meters apart) communicate and transfer data with each other. Various parameters like speed limit and GPS location can be set manually at the time of installation. And there are some other inputs like maintenance work, diversion, road block and accidents can also start manually by road safety authority. Node devices also has two lights red and green, green light is on by default and if there is any unwanted event or situation occurs then it start red light.**

Another device called user module or user device installed in vehicles. This device has GPS, accident detection sensors and an IoT Wi-Fi server. Vehicle can be LMV or HMV and their speed limits can also be different on different roads. Speed limits can be set at the time of installation into vehicle. When user enter into node mesh area his device connect with node and collect information from nodes like speed limit, road conditions, road clearance or blockage etc. The user device can collect and process all information. By using consecutive GPS locations and fix time interval frames it can be able to calculate vehicle's speed. User device also check this speed from road speed limits collected by nodes.

If vehicle speed is more than road speed limits than it generate user alert by buzzer. User vehicle also has accident detection sensors (Accelerometer Gyroscope and Vibration Sensor). Collectively both sensors detect accident of any degree. If such event happens the user device send a signal to the nearest node. And this information then transferred to all node mesh with event location with seriousness index. So that nearest emergency service can reach there within minimum time.

Keywords-Road Accident, Accidents, Road Safety, Road safety using IoT, Road safety Approach, Road Accident Safety.

I. INTRODUCTION

Presently, the IoT is one among the foremost important and promising technological topics. By 2020, it's estimated that there'll be up to 50.6 billion connected devices [1]. The IoT consists of everyday objects like physical devices, buildings, vehicles with embedded software, electronics, sensors, and network connectivity, that are capable to gather and exchanging data. The IoT is capable of transmitting the info over a network without counting on human-to-machine or human-to-human interaction. The IoT plays an important role in several fields like smart city, smart homes, health-care, banking, and education [2, 3].

In its Global Status Report on Road Safety – 2015, the planet Health Organization (WHO) noted that the worldwide total number of road traffic deaths has plateaued at 1.25 million per annum , with tens of million either injured or disabled [4]. Different initiatives, like the United Nations' initiative for the 2011-2020 Decade of Action for Road Safety, have led to improvements in road safety policies and enforcements. However, the WHO notes that the progress has been slow and has maintained the decision for urgent action to scale back these figures [5].The WHO describes different measures which will be implemented with minimal economic impacts in its "Save LIVES: Road Safety Technical Package" [4].

II. RELATED WORKS

A. **MobasshirMahbub** In this article a review has been performed on the technical background and the core supporting technologies of the narrow-band Internet of Things (NB-IoT) and the possible applications in perspective of conditions of Bangladesh. At the commencement of the paper, it introduced NB-IoT techs' background, history of development, and standardization. Then, described the features of NB-IoT by the recitation and review of research and studies currently performed and published on NB-IoT technology, in which the paper has focused on fundamental and core technologies regarding NB-IoT, analyzed several types of performance criterions of NB-IoT and compared other types of wireless technologies based on several performance indicator factors[6].

B. **Mir InshaMushtaq, Manish Kansal** A "Vehicle Collision Avoidance System" in an automobile system has the objective to develop safety features in automobiles so that there is avoidance of collision with vehicles or an obstacle in the way. In bad weather conditions these systems are especially useful. While driving the main objective of these systems is to prevent collision of car due to their carelessness or blind spot. These days vehicular communication is becoming popular[7].

C. **P.KaliugaLakshmi ,C.Thangamani** This paper present vehicle accident detection and alert system with SMS to the user defined mobile numbers. The platform of the system is MEMS, vibration sensor; GPS and GSM interfacing the alarm time to a large extend and locate the accident place. This system can overcome the problem of lack of automated accident detection. The accident can be detected by vibration sensor and MEMS sensor which will give the accurate information. The accident detection

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helps to provide security to the vehicle. So this system making the world a much better and safe place to live[8].

This paper overlooks similar existing systems and examines their advantages and disadvantages. There are a lot of systems that only detects accidents. There has not been a system to prevent and detect accidents at the same time in an efficient manner. This system issuing NB-IoT and GPS. This system detects a vehicle accident using vibration sensor and sends an alert to server for rescue. In this system, there is an accident prevention system. An IoT Approach to Vehicle Accident Detection probability and speed suggestions, Reporting, and navigation, proposed a rescuing process by reporting location of an accident with other information.

III. WORKING MODULE

- Vehicle system always collect vehicle vitals by built in sensors and process it.
- All vehicles share each other's data to node server when approaches.
- If any vehicle get critical condition then it send data to server with priority.
- Node server share this data with other vehicles when they approaches.
- Node can process and split data in required road distances e.g. 1km or 1mile
- Any critical condition or in disaster, node can contact with highway authorities.
- By getting GPS location node can also calculate speed of vehicle.
- Node send a warning message to vehicle display for maintain speed limits.

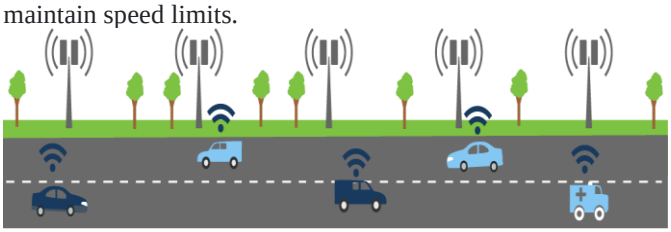

Fig.1 working diagram

A. Block Diagram

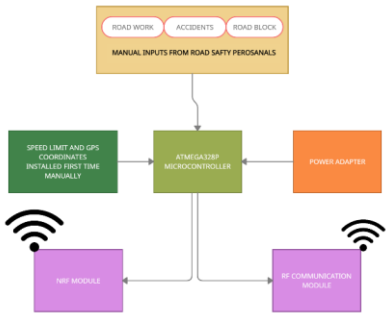

Fig.2 Block Diagram of Node

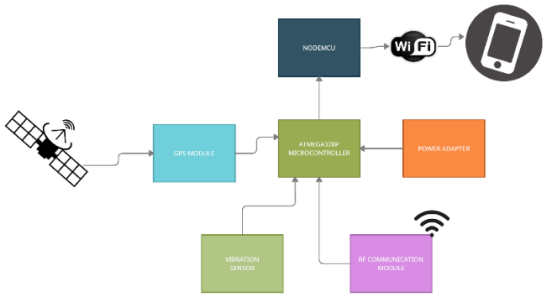

Fig.3 Block Diagram of User

IV. HARDWARE'S DESCRIPTIONS

A. Neo6m GPS Module:

Microduino-NEO module maybe the foremost beautiful GPS module. Its core module use UBLOX NEO-6M, high sensitivity, update rate up to 5Hz, using mini ceramic antenna with IPEX interface, and build-in a chargeable battery backup.

Fig.4 Neo6m GPS Module

B. NodeMCU:

NodeMCU is an open source firmware that open source prototyping board designs are available. The term "NodeMCU" properly speaking refers to the firmware instead of the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware relies on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, like lua-cjson and SPIFFS. It Support for the 32-bit ESP32 has also been implemented.

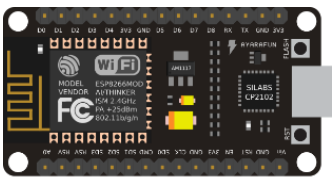

Fig.5 NodeMCU

C. HC-12:

HC-12 wireless interface communication module may be a new-generation multichannel embedded wireless data transmission module. Its wireless working band is 433.4-473.0MHz, multiple channels may be set, with the stepping of 400 KHz, and there are totally 100 channels. the most transmitting power of module is 100mW (20dBm), the receiving sensitivity is -117dBm at baud of 5,000bps within the air, and therefore the communication distance is 1,000m in open space.

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International Journal of Engineering Research & Technology (IJERT)
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Fig.6 HC-12 Module

D. 16x2 LCD:

A liquid-crystal display (LCD) may be a flat-panel display or other electronically modulated device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals don't emit light directly, instead employing a backlight or reflector to provide images in colour or monochrome. LCDs are available to display arbitrary images (as during a general-purpose computer display) or fixed images with low information content, which may be displayed or hidden, like preset words, digits, and seven-segment displays, as in a very digital clock. LCD modules are very commonly utilized in most embedded projects, the rationale being its cheap price, availability and programmer friendly. Most folk would have encounter these displays in our day to day life, either at PCO's or calculators. The looks and thus the pinouts have already been visualized above now allow us to urge slightly technical. 16×2 LCD is thought as so because; it's 16 Columns and a pair of Rows.

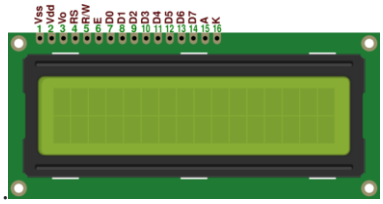

Fig.7 16x2 LCD Display

E. Arduino Nano:

The Arduino Nano is equipped with 30 male I/O headers, in a dip-30 like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-b micro-USB cable, or through a 9V battery.

Fig.8 Arduino Nano Board

F. nRF24L01+:

nRF24L01+ is also a single-chip radio transceiver for the worldwide 2.4-2.5 GHz ISM band. The radio transmitters and receivers include frequency generator, enhanced Shock Burst mode controller, power amplifier, oscillator modulator and demodulator. You'll select the output power channel and protocol by setting through the SPI port. the current consumption for the nRF24L01+ is extremely low - under the transmitter mode, when the transmitting power is 0dBm, the current consumption is just 11.3mA; under the receiving mode, it is 13.5mA; under the ability down and idle mode, the consumption is even lower. As for application, it's widely utilized in many devices like wireless mouse and keyboard, game handle, remote set, industry sensor, toys, etc.

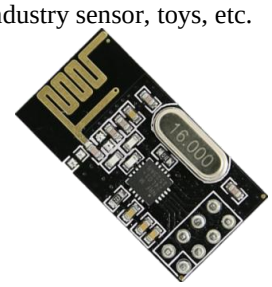

Fig.9 nRF24L01+ Module

G. Arduino Mega:

The Arduino Mega 2560 may be microcontroller board supported the ATmega2560. It has 54 digital input/output pins (of which 15 are often used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz quartz oscillator, a USB connection, an influence jack, an ICSP header, and a push button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to urge started.

Fig.10 Arduino Mega Board

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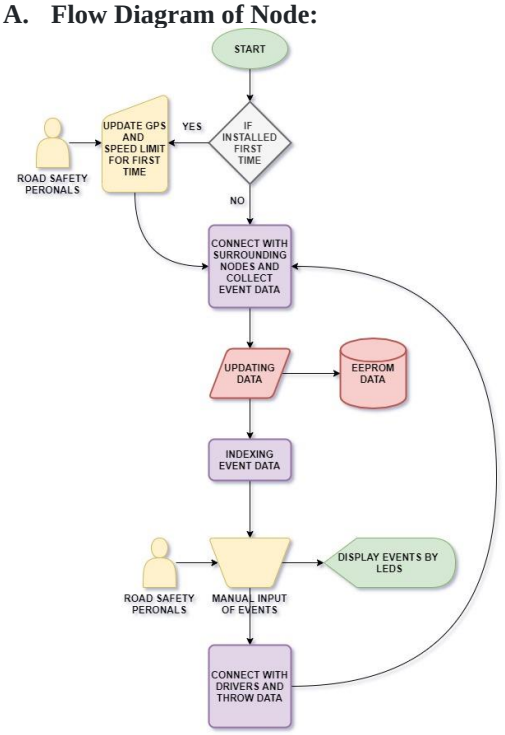
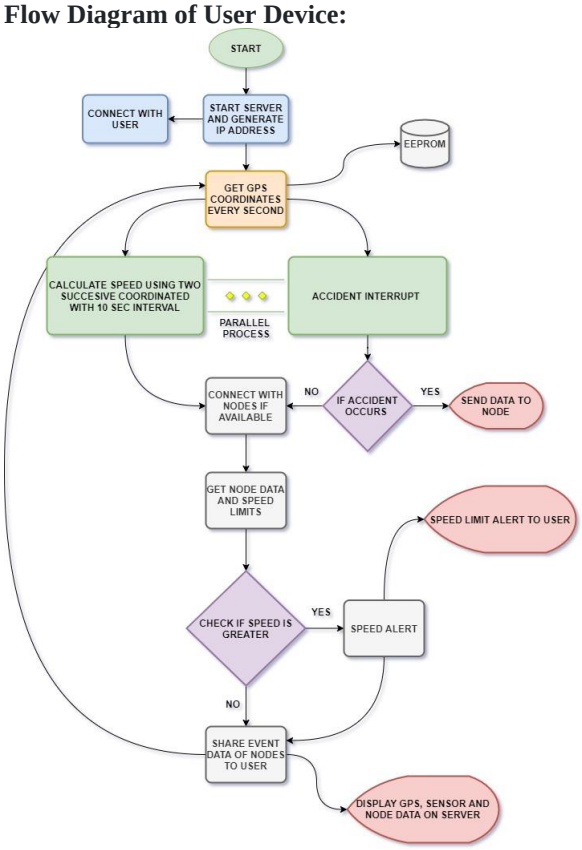
V. FLOW DIAGRAM

A. Flow Diagram of Node:



NODES FLOWCHART

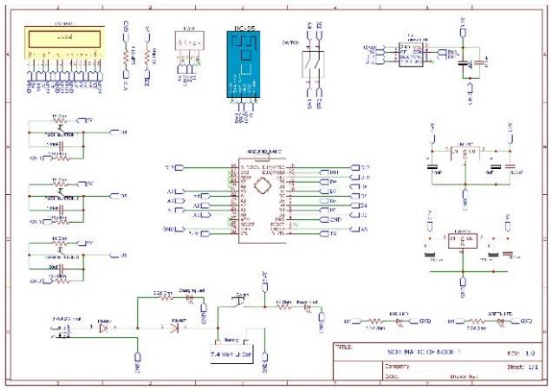
B. Flow Diagram of User Device:



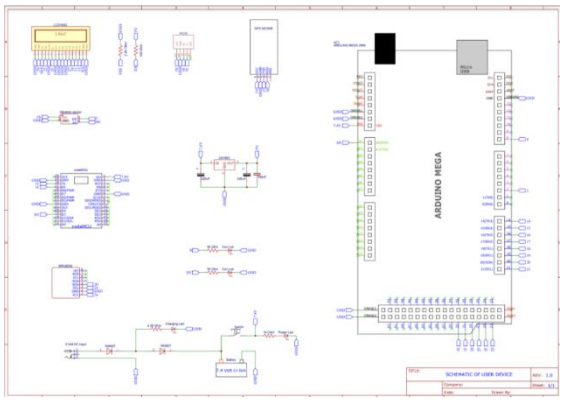
USER DEVICE FLOWCHART

VI. CIRCUIT DIAGRAM

A. Circuit Diagram of Node:



B. Circuit Diagram of user Device:



VII. RESULTS

The proposed system provides an excellent result to get real time data for any unwanted event in road safety. With the help of node technology, data of events move to and fro seamlessly. This technology is far better of GSM and other existing communication technologies to provide proper security and safety on highways.

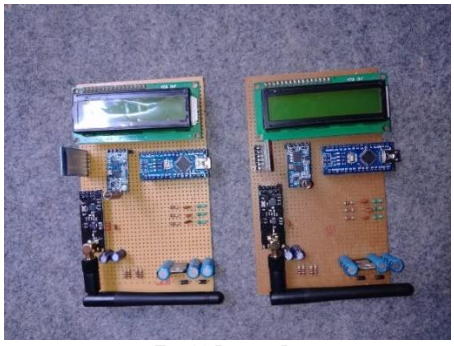


Fig.11 Project Image

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International Journal of Engineering Research & Technology (IJERT)
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Fig.12 Complete Project Image

VIII. APPLICATIONS

- This project can deploy in roadways for regulate road safety and security.
- A specific speed limit can managed by this project.
- It can be used in mountain areas where direct visibility is not possible.
- This project can working efficiently in foggy conditions where visibility is very low or negligible.

IX. FUTURE SCOPE

- Share its data with central server to apply better AI/ML algorithms for traffic.
- Vehicle driver can get accurate data more efficiently and early.
- AI can manage safety resources better.
- An integrated system with traffic lights can be attached for lighting.
- If there is no vehicle the light intensity is low.
- Collect many days' data to identify accident prone areas.
- Process many years' data to identify road maintenance and construction.

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