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"An IoT Based Accident Prevention & Tracking System For Night Drivers"

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This is to certify that **AISHWARYA S.R (1ME11EC002), ASHISH RAI (1ME11EC011), CHARITHA (1ME11EC017), PRASANTH M.A (1ME11EC050)**, has satisfactorily completed the technical final year project report on **"An IoT Based Accident Prevention & Tracking System for Night Drivers"** that has been approved as it satisfies the academic requirement in view of the final year project work prescribed for partial completion of the **VIII semester Bachelor of Engineering** in **Electronics and Communication Engineering** of the **Visvesvaraya Technological University, Belgaum during the year 2014-2015.**

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DECLARATION

We, Aishwarya S.R, Ashish Rai, Charitha & Prasanth M.A declare that the entire project work entitled " **An IoT Based Accident Prevention & Tracking System For Night Drivers**" is a project report of the original work accomplished at **MS Engineering College**, under the guidance of **SAVITHA S.C**, Assistant Professor, Dept. of ECE, MS Engineering College, Bangalore and no part of it has been submitted for any degree or diploma of any institution previously. The project work is submitted to **Visvesvaraya Technological University** Belgaum, at M.S. Engineering College Bangalore, for the partial fulfilment of Bachelor's degree in Electronics and Communication Engineering.

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ABSTRACT

Fatal Road accidents can be easily avoided by understanding the psychological state of drivers. Majority of road accidents occur during night driving due to drowsiness state of vehicle drivers (Subject). This paper provides Eye Blink Monitoring System (EBM) that alerts the subject during state of drowsiness. An embedded system based on psychological state of Subject by monitoring eye movements and head movements are useful in warning drivers during initial sleep cycle phase of drowsiness. The physiological sleep state analysis of subject can be determined by monitoring subject's eye-blink rate using an IR sensor and head movement using an accelerometer. A normal eye blink rate has no effect on the output of the system. However, if subject is in extreme state of sleep-cycle, then IR sensor receives abnormal eye blinking rate & an alarm is initiated to wake the subject. An Internet of Things (IOT) enabled sensors are used to transmit the entire data collected by sensors over a smart grid network for quick response team to take actions under emergency conditions.

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CHAPTER -1

Introduction

In recent years, driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries, deaths and significant economic losses. Statistics indicate the need of a reliable driver drowsiness detection system which could alert the driver before a mishap happens. Researchers have attempted to determine driver drowsiness using the following measures:

(1) vehicle-based measures

(2) behavioral measures

(3) physiological measures

This paper provides Eye Blink Monitoring System (EBM) that will alert the driver in drowsiness. A system for monitoring eye movements and head movements would be useful in warning drivers when they fall asleep. The driver's eye is continuously monitored using an IR sensor and head movement using accelerometer. The normal eye blink rate will have no effect on the output of the system. If driver falls asleep, then IR sensor receives abnormal eye blinking rate & an alarm will ring, to wake him/her up. An IOT enabled sensors are used to transmit the entire data collected by sensors over a smart grid network for quick response team to take actions under emergency conditions.

1.1 Defining Drowsiness

The term "drowsy" is synonymous with sleepy, which simply means an inclination to fall asleep. The stages of sleep can be categorized as awake, non-rapid eye movement sleep (NREM), and rapid eye movement sleep (REM). The second stage, NREM, can be subdivided into the following three stages :

Stage I: transition from awake to asleep (drowsy)

Stage II: light sleep

Stages III: deep sleep

In order to analyze driver drowsiness, researchers have mostly studied Stage I, which is the drowsiness phase. The crashes that occur due to driver drowsiness have a number of characteristics:

• Occur late at night (0:00 am–7:00 am) or during mid-afternoon (2:00 pm–4:00 pm)

• Involve a single vehicle running off the road

• Occur on high-speed roadways

• Driver is often alone

• Driver is often a young male, 16 to 25 years old

• No skid marks or indication of braking

In relation to these characteristics, the Southwest England and the Midlands Police databases use the following criteria to identify accidents that are caused by drowsiness :

• Blood alcohol level below the legal driving limit

• Vehicle ran off the road or onto the back of another vehicle

• No sign of brakes being applied

• Vehicle has no mechanical defect

• Good weather conditions and clear visibility

• Elimination of “speeding” or “driving too close to the vehicle in front” as potential causes

• The police officer at the scene suspects sleepiness as the primary cause

Statistics derived using these criteria cannot account fully for accidents caused by drowsiness because of the complexity involved; therefore, accidents that can be attributed to driver drowsiness may be more devastating than the statistics reveal. Hence, in order to avoid these types of accidents, it is necessary to derive effective measures to detect driver drowsiness and alert the driver during the peak drowsiness periods of 2:00 am to 6:00 am and 2:00 pm to 4:00 pm. During these time frames, the circadian rhythm shows higher chance of getting drowsy and drivers are three times more likely to fall asleep at these times than at 10:00 am or at 7:00 pm The circadian rhythm produces small, but significant, changes in vehicle-based measures. Researchers have asked subjects to drive between 2:30 pm and 5:30 pm in order to monitor drowsiness by measuring eyelid movement, ECG and EEG. The duration of the driving task also plays a major role in influencing drowsiness. It is found that sleep deprivation alone does not directly influence the brain signals that control drowsiness, whereas the duration of task has a strong influence. Researchers have also inferred that prolonged driving on a monotonous environment stimulates drowsiness. In fact, it has been observed that the subjects can become drowsy within 20 to 25 min of driving. This last finding contradicts the observation that, in a real environment, the duration of the drive does not impact the performance during the first two hours. In addition, researchers have found that drowsiness-related crashes are more probable in a monotonous environment than in a stimulating environment. Therefore, there is a very high probability that a partially sleep-deprived driver will become drowsy when driving in a monotonous environment at a constant speed for three hours during a time when their circadian rhythm is low. This should be taken into consideration when designing an experiment relating to recording driver drowsiness.

1.1.1 Methods for Measuring Drowsiness

Researchers have used various methods to measure driver drowsiness. This section provides review of the four most widely-used methods, among which the first method is measured either verbally or through questionnaire and the remaining three by means of various sensors.

a) Subjective Measures

Subjective measures that evaluate the level of drowsiness are based on the driver's personal estimation and many tools have been used to translate this rating to a measure of driver drowsiness. The most commonly used drowsiness scale is the Karolinska Sleepiness Scale (KSS), a nine-point scale that has verbal anchors for each step measured by KSS ratings of drivers every 5 min and used it as a reference to the EoG signal collected. The evaluated EEG data by confirming driver drowsiness through both a questionnaire and a licensed medical practitioner. Some researchers compared the self-determined KSS, which was recorded every 2 min during the driving task, with the variation of lane position (VLP) and found that these measures were not in agreement . Ingre *et al.* determined a relationship between the eye blink duration and the KSS collected every 5 min during the driving task. Researchers have determined that major lane departures, high eye blink duration and drowsiness-related physiological signals are prevalent for KSS ratings between 5 and 9 . However, the subjective rating does not fully coincide with vehicle-based, physiological and behavioral measures because the level of drowsiness is measured approximately every 5 min, sudden variations cannot be detected using subjective measures. Another limitation to using subjective ratings is that the self-introspection alerts the driver, thereby reducing their drowsiness level. In addition, it is difficult to obtain drowsiness feedback from a driver in a real driving situation. Therefore, while subjective ratings are useful in determining drowsiness in a simulated environment, the remaining measures may be better suited for the detection of drowsiness in a real environment.

Rating	Verbal descriptions
1	Extremely alert
2	Very alert
3	Alert
4	Fairly alert
5	Neither alert nor sleepy
6	Some signs of sleepiness
7	Sleepy, but no effort to keep alert
8	Sleepy, some effort to keep alert
9	Very sleepy, great effort to keep alert

Table 1. Karolinska sleepiness scale (KSS).

b) Vehicle-Based Measures

Another method to measure driver drowsiness involves vehicle-based measurements. In most cases, these measurements are determined in a simulated environment by placing sensors on various vehicle components, including the steering wheel and the acceleration pedal; the signals sent by the sensors are then analyzed to determine the level of drowsiness. Some researchers found that sleep deprivation can result in a larger variability in the driving speed. However, the two most commonly used vehicle-based measures are the steering wheel movement and the standard deviation of lane position.

i) Steering Wheel Movement (SWM) :

It is measured using steering angle sensor and it is a widely used vehicle-based measure for detecting the level of driver drowsiness. Using an angle sensor mounted on the steering column, the driver's steering behavior is measured. When drowsy, the number of micro-corrections on the steering wheel reduces compared to normal driving. It is found that sleep deprived drivers made fewer steering wheel reversals than normal drivers. To eliminate the effect of lane changes, the researchers considered only small steering wheel movements (between 0.5° and 5°), which are needed to adjust the lateral position within the lane . Hence, based on small SWMs, it is possible to determine the drowsiness state of the driver and thus provide an alert if needed. In a simulated environment, light side winds that pushed the car to the right side of the road were added along a curved road in order to create variations in the lateral position and force the drivers to make corrective SWMs. Car companies, such as Nissan and Renault, have adopted SWMs but it works in very limited situations. This is because they can function reliably only at particular environments and are too dependent on the geometric characteristics of the road and to a lesser extent on the kinetic characteristics of the vehicle.

ii) Standard Deviation of Lane Position (SDLP)

It is another measure through which the level of driver drowsiness can be evaluated. In a simulated environment, the software itself gives the SDLP and in case of field experiments the position of lane is tracked using an external camera. In an experiment to derive numerical statistics based on SDLP and found that, as KSS ratings increased, SDLP (meters) also increased. For example, KSS ratings of 1, 5, 8, and 9 corresponded to SDLP measurements of 0.19, 0.26, 0.36 and 0.47, respectively. The SDLP was calculated based on the average of 20 participants; however, with some drivers, the SDLP did not exceeded 0.25 m even for a KSS rating of 9. In the above experiment by performing correlation analysis on a subject to subject basis significant difference is noted. Another limitation of SDLP is that it is purely dependent on external factors like road marking, climatic and lighting conditions. In summary, many studies have determined that vehicle-based measures are a poor predictor of performance error risk due to drowsiness. Moreover, vehicular-based metrics are not specific to drowsiness. SDLP can also be caused by any type of impaired driving, including driving under the influence of alcohol or other drugs, especially depressants.

c) Behavioral Measures

A drowsy person displays a number of characteristic facial movements, including rapid and constant blinking, nodding or swinging their head, and frequent yawning . Computerized, non-intrusive, behavioral approaches are widely used for determining the drowsiness level of drivers by measuring their abnormal behaviors. Most of the published studies on using behavioral approaches to determine drowsiness, focus on blinking. PERCLOS (which is the percentage of eyelid closure over the pupil over time, reflecting slow eyelid closures, or “droops”, rather than blinks)has been analyzed in many studies. This measurement has been found to be a reliable measure to predict drowsiness and has been used in commercial products such as Seeing Machines and Lexus. Some researchers used multiple facial actions, including inner brow rise, outer brow rise, lip stretch, jaw drop and eye blink, to detect drowsiness. However, research on using other behavioral measures, such as yawning and head or eye position orientation, to determine the level of drowsiness is ongoing. The main limitation of using a vision-based approach is lighting. Normal cameras do not perform well at night. In order to overcome this limitation, some researchers have used active illumination utilizing an infrared Light Emitting Diode (LED). However, although these work fairly well at night, LEDs are considered less robust during the day. In addition, most of the methods have been tested on data obtained from drivers mimicking drowsy behavior rather than on real video data in which the driver gets naturally drowsy. Mostly, image is acquired using simple CCD or web camera during day and IR camera during night at around 30 fps. After capturing the video, some techniques, including Connected Component Analysis, Cascade of Classifiers or Hough Transform, Gabor Filter, HAAR Algorithm are applied to detect the face, eye or mouth. After localizing the specific region of interest within the image, features such as PERCLOS, yawning frequency and head angle, are extracted using an efficient feature extraction technique, such as Wavelet Decomposition, Gabor Wavelets, Discrete Wavelet Transform or Condensation Algorithm. The behavior is then analyzed and classified as either normal, slightly drowsy, highly drowsy through the use of classification methods such as support vector machine, fuzzy classifier, neural classifier and linear discriminent analysis. However, it has been found that the rate of detecting the correct feature, or the percentage of success among a number of detection attempts, varies depending on the application and number of classes. The determination of drowsiness using PERCLOS and Eye Blink has a success rate of close to 100% and 98%, respectively. However it has to be noted that, the high positive detection rate achieved by [43] was when the subjects didn't wear glasses. Likewise, as most researchers conducted their experiments in simulated environment they achieved a higher success rate. The positive detection rate decreased significantly when the experiment was carried out in a real environment.

d) Physiological Measures

As drivers become drowsy, their head begins to sway and the vehicle may wander away from the center of the lane. The previously described vehicle-based and vision based measures become apparent only after the driver starts to sleep, which is often too late to prevent an accident. However, physiological signals start to change in earlier stages of drowsiness. Hence, physiological signals are more suitable to detect drowsiness with few false positives; making it possible to alert a drowsy driver in a timely manner and thereby prevent many road accidents. Many researchers have considered the following physiological signals to detect drowsiness: electrocardiogram (ECG), electromyogram (EMG), electroencephalogram (EEG) and electro-oculogram(EoG). Some researchers have used the EoG signal to identify driver drowsiness through eye movements . The electric potential difference between the cornea and the retina generates an electrical field that reflects the orientation of the eyes; this electrical field is the measured EoG signal. Researchers have investigated horizontal eye movement by placing a disposable Ag-Cl electrode on the outer corner of each eye and a third electrode at the center of the forehead for reference . The electrodes were placed as specified so that the parameters - Rapid eye movements (REM) and Slow Eye Movements (SEM) which occur when a subject is awake and drowsy respectively, can be detected easily. The heart rate (HR) also varies significantly between the different stages of drowsiness, such as alertness and fatigue . Therefore, heart rate, which can be easily determined by the ECG signal, can also be used to detect drowsiness. Others have measured drowsiness using Heart Rate Variability (HRV), in which the low (LF) and high (HF) frequencies fall in the range of 0.04–0.15 Hz and 0.14–0.4 Hz, respectively. HRV is a measure of the beat-to-beat (R-R Intervals) changes in the heart rate. The ratio of LF to HF in the ECG decreases progressively as the driver progresses from an awake to a drowsy state. The Electroencephalogram (EEG) is the physiological signal most commonly used to measure drowsiness. The EEG signal has various frequency bands, including the delta band (0.5–4 Hz), which corresponds to sleep activity, the theta band (4–8 Hz), which is related to drowsiness, the alpha band (8–13 Hz), which represents relaxation and creativity, and the beta band (13–25 Hz), which corresponds to alertness. A decrease in the power changes in the alpha frequency band and an increase in the theta frequency band indicates drowsiness. Akin *et al.* observed that the success rate of using a combination of EEG and EMG signals to detect drowsiness is higher than using either signal alone. The measurement of raw physiological signals is always prone to noise and artifacts due to the movement that is involved with driving. Hence, in order to eliminate noise, various preprocessing techniques, such as low pass filter, digital differentiators, have been used. In general, an effective digital filtering technique would remove the unwanted artifacts in an optimal manner. A number of statistical features are then extracted from the processed signal using various feature extraction techniques, including Discrete Wavelet Transform (DWT) and Fast Fourier Transform (FFT) . The extracted features are then classified using Artificial Neural Networks (ANN), Support Vector Machines (SVM), Linear Discriminant Analysis (LDA), or other similar methods. The reliability and accuracy of driver drowsiness detection by using physiological signals is very high compared to other methods. However, the intrusive nature of measuring physiological signals remains an issue to be addressed. To overcome this, researchers have used wireless devices to measure physiological signals in a less intrusive manner by placing the electrodes on the body and obtaining signals using wireless technologies like Zigbee , Bluetooth . Some researchers have gone further ahead by measuring physiological signals in a non intrusive way; by placing electrodes on the steering wheel or on the driver's seat. The signals obtained were then processed in android based smart phone devices and the driver was alerted on time. The accuracy of a non-intrusive system is relatively less due to movement artifacts and errors that occur due to improper electrode contact. However, researchers are considering to use this because of its user friendliness. In recent years, experiments are conducted to validate non-intrusive systems.

1.1.2 Internet of things:

The **Internet of Things** (**IOT**) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IOT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to be implemented in nearly all fields of automation enabling advanced applications like a Smart Grid.

The term "things" in the IOT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize WiFi for remote monitoring. Integration with the Internet implies that devices will utilize an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows for 4.3 billion unique addresses), objects in the IOT will have to use IPv6 to accommodate the extremely large address space required. Objects in the IOT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet). Largely, the future of the Internet of Things will not be possible without the support of IPv6; and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IOT in the future.

1.1.3 Future Vision Of Internet Of Things

The Internet of Things is a vision which is under development and there can be many stake holders in this development depending upon their interests and usage. It is still in nascent stages where everybody is trying to interpret IoT in with respect to their needs. Sensor based data collection, data management, data mining and World Wide Web is involved in the present vision. Of course sensor based hardware is also involved. A simple and broad definition of the internet of things and the basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals. Fig. 1 has been discussion on three particular visions given by the following as indicated below :

• Things Oriented Vision

• Internet Oriented Vision

• Semantic Oriented Vision

a) Things Oriented Vision

This vision is supported by the fact that we can track anything using sensors and pervasive technologies using RFID. The basic philosophy is uniquely identifying any object using specifications of Electronic Product Code (EPC) .This technique is extended using sensors. It is important to appreciate the fact that future vision will depend upon sensors and its capabilities to fulfill the "things" oriented vision. We will be able to generate the data collectively with the help of sensors, and sensor type embedded system. The summarized vision will be dependent upon sensor based networks as well as RFID-based Sensor Networks which will take care of the integration of technology based on RFID and sophisticated sensing and computing devices and the global connectivity.

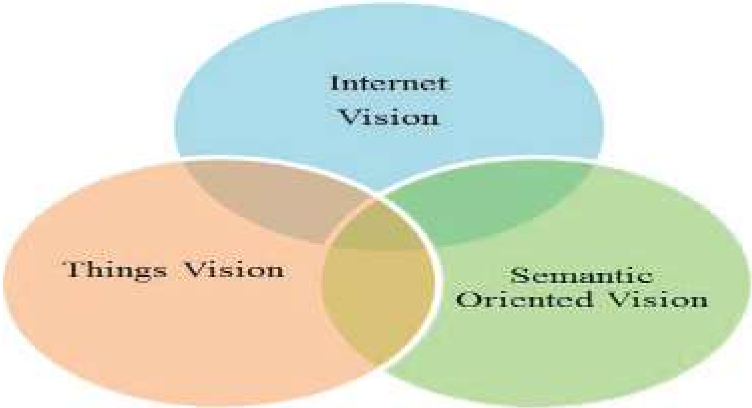


Fig.1 Three main visions of Internet of Things.

b) Internet Oriented Vision

The internet-oriented vision has pressed upon the need to make smart objects which are connected. The objects need to have characteristics of IP protocols as this is one of the major protocols being followed in the world of Internet. The sensor based object can be converted in to an understandable format, which can be identified uniquely and its attributes can be continuously monitored. This makes the base for smart embedded objects which can be assumed to be a microcomputers having computing resources.

c) Semantic Oriented Vision

This vision is powered by the fact that the amount of sensors which will be available at our disposal will be huge and the data that they will collect will be massive in nature. Thus we will have vast amount of information, possibly redundant, which needs to be processed meaningfully. The raw data needs to be managed, processed and churned out in an understandable manner for better representations and understanding. If we are able to make the sets of data into homogeneous and heterogeneous formats then the interoperability issues of understanding the data will be dependent upon the semantic technologies to process the data. It is here that needs a generic vision of processing the raw data in to meaningful data and a marked separation of data and their interpretation.

1.2 Block Diagram

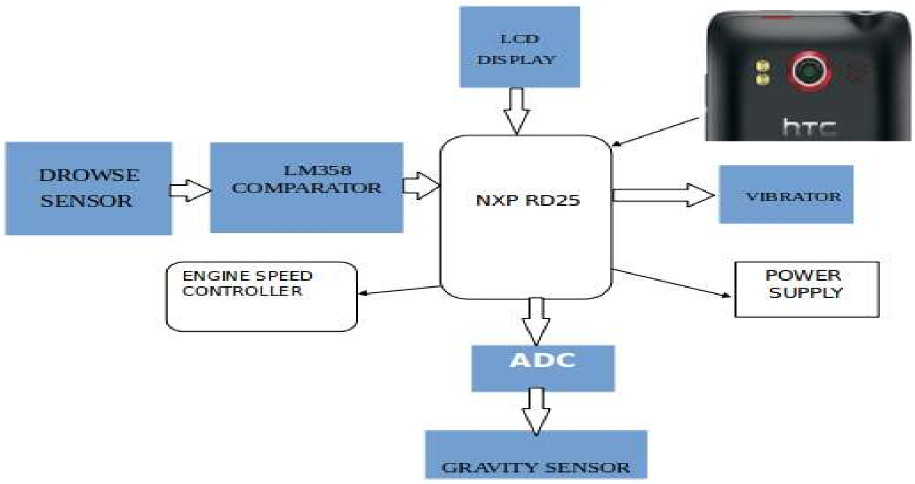


Fig 2 : block diagram of designed embedded system

1.2.1 Description Of Block Diagram

This project involves measurement of eye blink using IR sensor and head movement using accelerometer. The IR transmitter is used to transmit the infrared rays in our eye. The IR receiver is used to receive the reflected infrared rays of eye. If the eye is closed then the output of IR receiver would be high ,otherwise the IR receiver output is low. To know whether the eye is in closing or opening position. The output is provided to a logic circuit for alarm indication and status will displayed on LCD display. Accelerometer is placed on driver fore-head it measures tilt angle of the drivers in vertical either forward or backward direction and left or right direction from the driver knee. If tilting angle exceeds certain threshold range, This output is give to logic circuit to indicate the alarm and status is displayed on LCD.

1.2.2 Monitoring Eye Movement

By monitoring the eye of a human being, we can determine whether he/she is sleeping or not. One common technique of monitoring eye blink rate is by measuring infrared (IR) light reflected from the surface of the eye. The eye is illuminated by an IR LED, which is powered by the +5V power supply and the reflected light is recorded by an IR photo diode. The IR photo diode converts this reflected light into electrical signal and given to Op-Amp. The output of Op-Amp Depends on the intensity of light received by the IR photo diode. The micro-controller drives the buzzer according to output of Op-Amp. The digital display provides various messages to the user. When the eye is open, maximum amount of light will be reflected from the eye because our eyeball is transparent, while minimum of light will be reflected from the eye, when it is closed as skin part of eye is opaque.

1.2.3 Monitoring Head Movement

Head movement detection is done through single step Accelerometer eg: ADXL330 which measures 3-axis detection. It consists of angle based accelerometer (ACC) input to simulate accurate head movement. For the movement analysis, it is needed to somehow translate the tilt angle data to displacement of mouse cursor that is calculating new head position.

There are two main methods when calculating the new head cursor position:

- Absolute mapping in which every tilt angle corresponds to a position on screen.
- Relative mapping in which every tilt angle corresponds to a head displacement amount (step size) and this amount is summed by the coordinates of the head's old position, to calculate new position.

1.3 Need For Project

The project is designed to accomplish safe driving on roads by providing solutions to following aspects :

1. Solution for night drivers when they feel sleepy while driving overnight to wake them up
2. Solution for drunkards when they are over drunk wake them when they are drowsing
3. Solution for rash driving , cut the speed by stoping the spark to the starter or sparkplug & wake them up

4. Solution for wheel grip using gravity sensor
5. Advice for drivers by their loved ones when they are overdrunk or rash driving
6. Solution for preventing accidents
7. Solution for detecting accidents using impact sensors
8. Solution for tracking & locating the location of accident using GPS.

1.4 Motivation For The Project

The project is motivated by the following factors:

1. To preventing accident before it's occurrence hence, increases the safety of both person driving the vehicle and other people on roads.
2. To assist emergency services and quick response teams to take quick action in case of occurrence.
3. To enable effective implementation of safety regulations for four-wheel drive on roads at both day and night.
4. To provide a user friendly safety device for vehicle drivers.
5. To prevents over speeding of vehicles and maintains vehicle stability.
6. Fast growth and cheap availability of Smart grid and cloud services.

1.5 Thesis Organization

- **CHAPTER-1 :** The chapter-1 contains the introduction of the designed project and basic motivating factors in accomplishing the project idea.
- **CHAPTER-2:** The chapter-2 contains the background theory containing project specifications determined by the Architecture module of 8051 along with configuration details of drowse sensors (RFID), LM358 comparator,16 X 2 LCD display, Alarm systems and Gravity sensors.
- **CHAPTER-3:** The chapter-3 contains the essential information pertaining to literature survey, gaps in literature, summary and future enhancements.
- **CHAPTER-4:** The chapter-4 consists of problem definition, problem statement, aims & objectives, methodology, resource requirement and GANTT chart.
- **CHAPTER-5:** The chapter-5 contains the details of design flow, design details, mathematical model and hardware model.
- **CHAPTER-6:** The Chapter-6 contains the results concluded by the implementation of the designed model after required testing and simulation on the prototype.
- **CHAPTER-7:** The Chapter-7 contains the details about the conclusions concluded from the designed project and its scope for improvement in future. The references and appendix sections are included to verify the claims of given project

CHAPTER -2

BACKGROUND THEORY

The proposed model utilizes a 8051 microcontroller for processing data. An integrated network of sensors are used to collect data from various sources. The microcontroller acts as a heart of the the embedded designed system. The essential devices that utilized in the proposed prototype model are given below :

1. MICROCONTROLLER
2. LCD : Liquid Crystal Display
3. Sensors : a) IR- sensors: Infrared Sensors

   b) G- sensors : Gravity sensors
4. Comparator LM358
5. Alarm System

2.1 Micro controller

A **microcontroller** (sometimes abbreviated **µC** or **MCU**) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping

(CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

2.1.1 8051 Microcontroller

The 8051 Microcontroller is a Microcontroller designed by Intel in 1980's. It was based on Harvard Architecture and developed primarily for use in Embedded Systems. Originally it was developed using NMOS technology but as those requires more power to operate therefore Intel redesigned Microcontroller 8051 using CMOS technology and later versions came with a letter 'C' in their name, for example: 80C51. These latest Microcontrollers requires less power to operate as compared to their predecessors. Microcontroller 8051 has two buses for program and data. Thus it has two memory spaces of 64K X 8 size for both program and data. It has an 8 bit processing unit and 8 bit accumulator. It also includes 8 bit B register as main processing blocks. It also have some other 8 bit and 16 bit registers. Microcontroller 8051 have an built in RAM for internal processing. This memory is primary memory and is used for storage of temporary data. It is Volatile memory i.e. its contents get vanished when the power is turned OFF. Following is the block diagram of Microcontroller 8051. Let us have a look at each part or block of this Architecture:

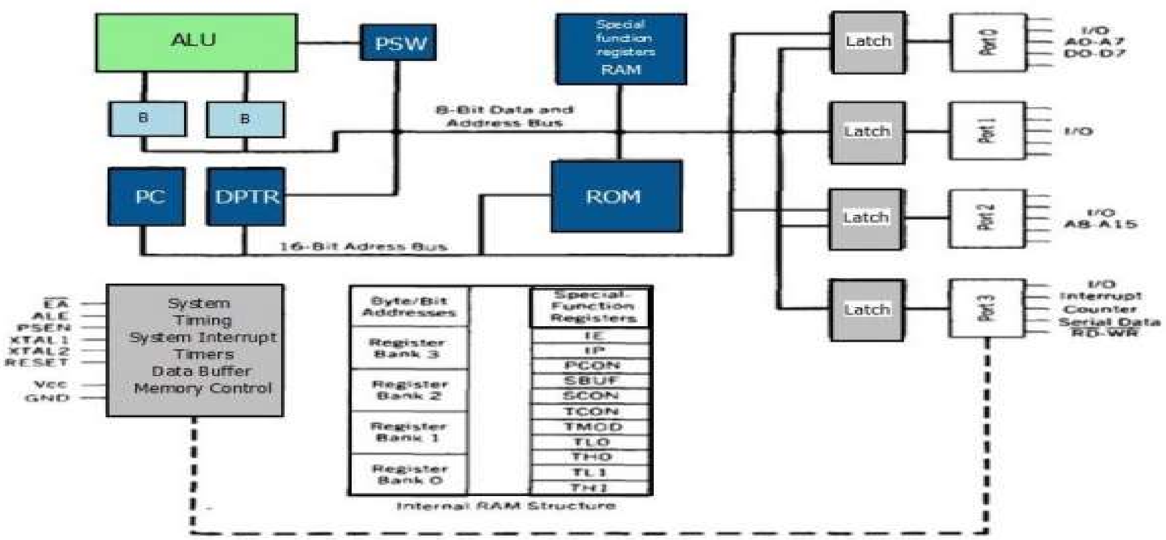


Fig :3 Microcontroller 8051 - Block Diagram

2.1.2 Specification Of Microcontroller

1. Central Processor Unit(CPU): As you may know that CPU is the brain of any processing device. It monitors and controls all operations that are performed in the Microcontroller. User have no control over the work of CPU. It reads program written in ROM memory and executes.

2. Interrupts: As its name suggests, Interrupt is a subroutine call that interrupts Microcontroller's main operation or work and causes it to execute some another program which is more important at that time. The feature of Interrupt is very useful as it helps in cases of emergency. Interrupts gives us a mechanism to put on hold the ongoing operation , execute a subroutine and then again resumes normal program execution. The Microcontroller 8051 can be configured in such a way that it temporarily terminates or pause the main program at the occurrence of interrupt. When subroutine is completed then the execution of main program starts as usual. There are five interrupt sources in 8051 Microcontroller. Two of them are external interrupts and two timer interrupts and one serial port interrupt.

3. Memory: Microcontroller requires a program which is a collection of instructions. This program tells Microcontroller to do specific tasks. These programs requires a memory on which these can be saved and read by Microcontroller to perform specific operation. The memory which is used to store the program of Microcontroller, is known as code memory or Program memory. It is known as **'ROM'**(**Read Only Memory**). Microcontroller also requires a memory to store data or operands temporarily. The memory which is used to temporarily store data for operation is known as Data Memory and we uses **'RAM'**(**Random Access Memory**) for this purpose. Microcontroller 8051 has 4K of Code Memory or Program memory that is it has 4KB Rom and it also have 128 bytes of data memory i.e. RAM.

4. Bus: Basically Bus is a collection of wires which work as a communication channel or medium for transfer of Data. These buses consists of 8, 16 or more wires. Thus these can carry 8 bits, 16 bits simultaneously. Buses are of two types:

- Address Bus
- Data Bus

4a) Address Bus: Microcontroller 8051 has a 16 bit address bus. It used to address memory locations. It is used to transfer the address from CPU to Memory.

4b) Data Bus: Microcontroller 8051 has 8 bits data bus. It is used to carry data.

5. Oscillator: As we know Microcontroller is a digital circuit device, therefore it requires clock for its operation. For this purpose, Microcontroller 8051 has an on-chip oscillator which works as a clock source for Central Processing Unit. As the output pulses of oscillator are stable therefore it enables synchronized work of all parts of 8051 Microcontroller.

6. Input/Output Port: As we know that Microcontroller is used in Embedded systems to control the operation of machines. Therefore to connect it to other machines, devices or peripherals we requires I/O interfacing ports in Microcontroller. For this purpose Microcontroller 8051 has 4 input output ports to connect it to other peripherals.

7. Timers/Counters: Microcontroller 8051 has 2 16 bit timers and counters. The counters are divided into 8 bit registers. The timers are used for measurement of intervals , to determine pulse width etc.

2.1.3 Features Of 8051

The Intel 8051 is a Harvard architecture, single chip microcontroller (μC) which was developed by Intel in 1980 for use in embedded systems. 8051 is an 8-bit micro controller. The Important features of 8051 Architecture along with the Pin diagram are given below :

- 8-bit ALU, Accumulator and Registers;
- 8-bit data bus - It can access 8 bits of data in one operation
- 16-bit address bus - It can access 216 memory locations - 64 kB (65536 locations) each of RAM and ROM
- On-chip RAM - 128 bytes ("Data Memory")
- On-chip ROM - 4 kB ("Program Memory")
- Four byte bi-directional input/output port
- UART (serial port)
- Two 16-bit Counter/timers

- Two-level interrupt priority & Power saving mode

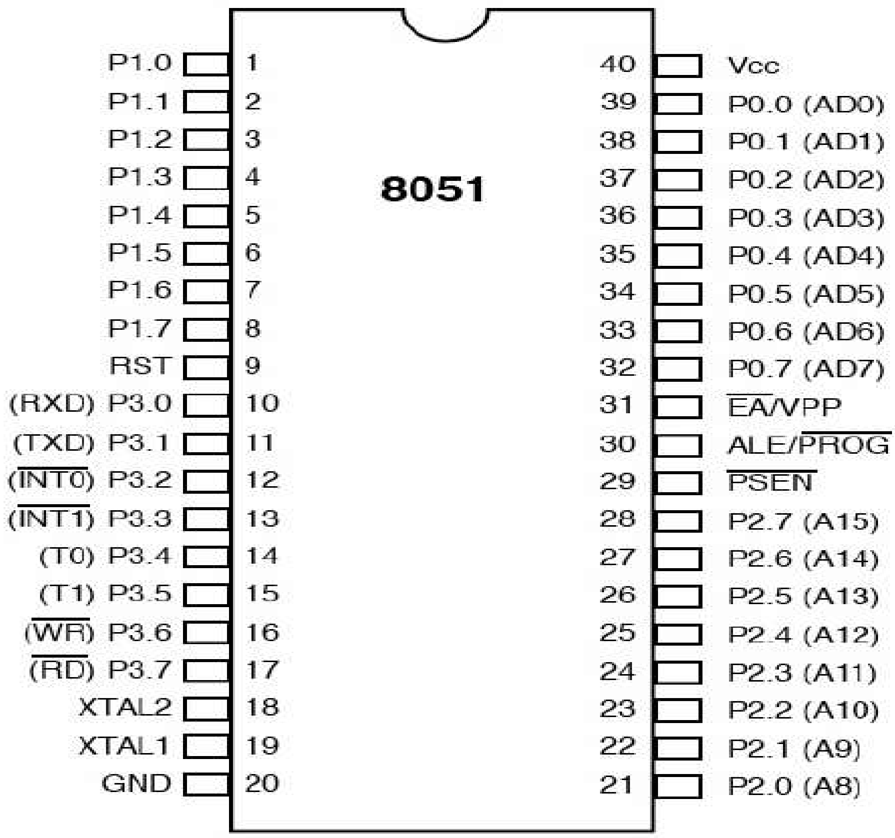


Fig 4 : Pin Diagram OF 8051

2.2 LCD :Liquid Crystal Display

The most common application of liquid crystal technology is in liquid crystal displays (LCDs). From the ubiquitous wrist watch and pocket calculator to an advanced VGA computer screen, this type of display has evolved into an important and versatile interface. A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present information. This basic idea is common to all displays, ranging from simple calculators to a full color LCD television. LCD consists primarily of two glass plates with some liquid crystal material between them. There is no bulky picture tube. This makes LCDs practical for applications where size (as well as weight) are important. In general, LCDs use much less power than their cathode-ray tube (CRT) counterparts. Many LCDs are reflective, meaning that they use only ambient light to illuminate the display. Even displays that do require an external light source (i.e. computer displays) consume much less power than CRT devices.

2.2.1 The 16×2 LCD module

16×2 LCD module is a very common type of LCD module that is used in 8051 based embedded projects. It consists of 16 rows and 2 columns of 5×7 or 5×8 LCD dot matrices. The module were are talking about here is type number JHD162A which is a very popular one . It is available in a 16 pin package with back light ,contrast adjustment function and each dot matrix has 5×8 dot resolution. The pin numbers, their name and corresponding functions are shown in the table below. VEE pin is meant for adjusting the contrast of the LCD display and the contrast can be adjusted by varying the voltage at this pin. This is done by connecting one end of a POT to the Vcc (5V), other end to the Ground and connecting the center terminal (wiper) of of the POT to the VEE pin. See the circuit diagram for better understanding. The JHD162A has two built in registers namely data register and command register. Data register is for placing the data to be displayed , and the command register is to place the commands. The 16×2 LCD module has a set of commands each meant for doing a particular job with the display. We will discuss in detail about the commands later. High logic at the RS pin will select the data register and Low logic at the RS pin will select the command register. If we make the RS pin high and the put a data in the 8 bit data line (DB0 to DB7) , the LCD module will recognize it as a data to be displayed . If we make RS pin low and put a data on the data line, the module will recognize it as a command. R/W pin is meant for selecting between read and write modes. High level at this pin enables read mode and low level at this pin enables write mode. E pin is for enabling the module. A high to low transition at this pin will enable the module. DB0 to DB7 are the data pins. The data to be displayed and the command instructions are placed on these pins. LED+ is the anode of the back light LED and this pin must be connected to Vcc through a suitable series current limiting resistor. LED- is the cathode of the back light LED and this pin must be connected to ground

PIN NO:	NAME	FUNCTION
1	VSS	This pin must be connected to the ground
2	VCC	Positive supply voltage pin (5V DC)
3	VEE	Contrast adjustment
4	RS	Register selection
5	R/W	Read or write
6	E	Enable
7	DB0	Data
8	DB1	Data
9	DB2	Data
10	DB3	Data
11	DB4	Data
12	DB5	Data
13	DB6	Data
14	DB7	Data
15	LED+	Back light LED+
16	LED-	Back light LED-

Table 2 : LCD PIN Configuration

2.2.2 The 16×2 LCD module commands:

16×2 LCD module has a set of preset command instructions. Each command will make the module to do a particular task. The commonly used commands and their function are given in the table below.

COMMAND	FUNCTION
0F	LCD ON, Cursor ON, Cursor blinking ON
01	Clear screen
2	Return home
4	Decrement cursor
06	Increment cursor
E	Display ON ,Cursor ON
80	Force cursor to the beginning of 1st line
C0	Force cursor to the beginning of 2nd line
38	Use 2 lines and 5×7 matrix
83	Cursor line 1 position 3
3C	Activate second line
0C3	Jump to second line, position3
OC1	Jump to second line, position1

Table 3 : LCD module Command

2.2.3 LCD initialization

The steps that has to be done for initializing the LCD display is given below and these steps are common for almost all applications.

- Send 38H to the 8 bit data line for initialization
- Send 0FH for making LCD ON, cursor ON and cursor blinking ON.
- Send 06H for incrementing cursor position.
- Send 01H for clearing the display and return the cursor.

2.2.4 Sending data to the LCD

The steps for sending data to the LCD module is given below. I have already said that the LCD module has pins namely RS, R/W and E. It is the logic state of these pins that make the module to determine whether a given data input is a command or data to be displayed.

- Make R/W low.
- Make RS=0 if data byte is a command and make RS=1 if the data byte is a data to be displayed.
- Place data byte on the data register.
- Pulse E from high to low.
- Repeat above steps for sending another data.

2.2.5 LCD Interface Circuit diagram

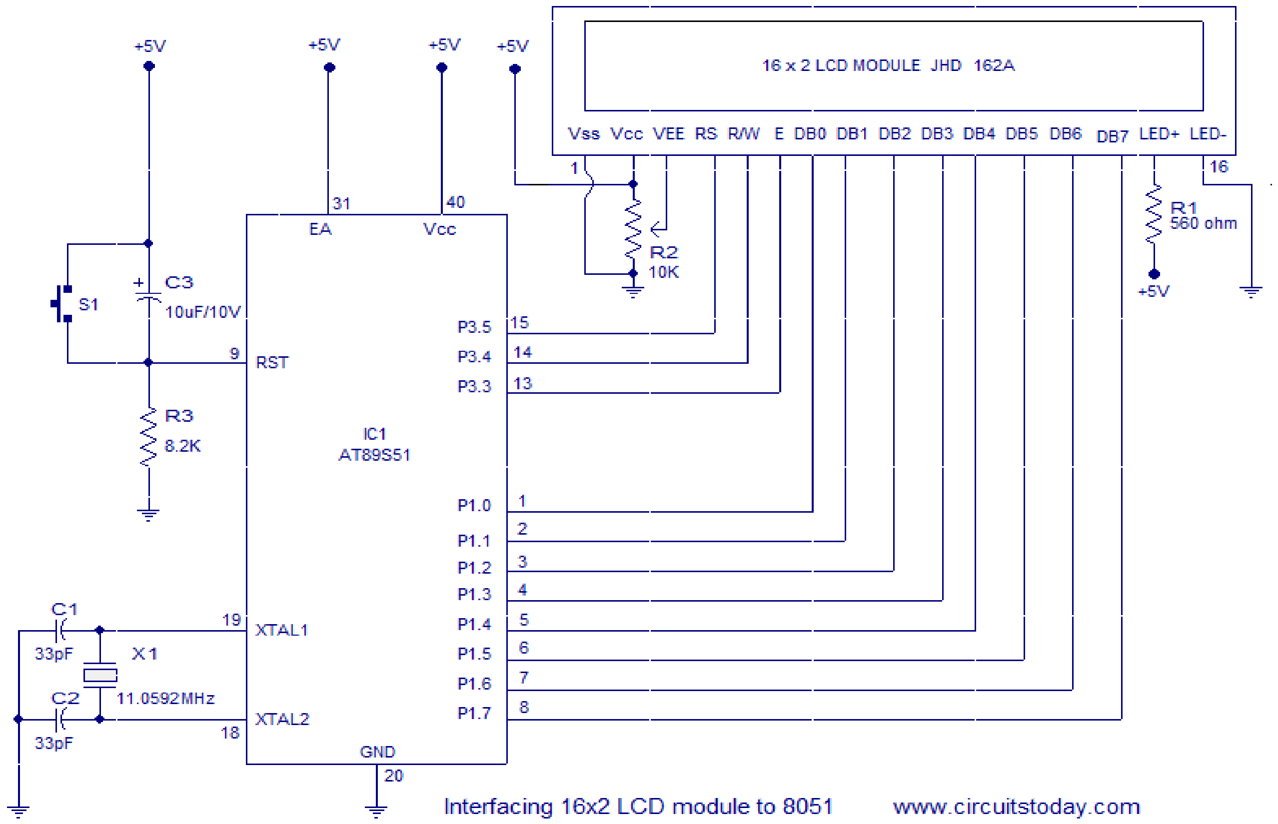


Fig 5 : 16 x 2 LCD interfacing with 8051

2.2.6 Interfacing 16×2 LCD module to 8051

The circuit diagram given above (fig 5) shows how to interface a 16×2 LCD module with AT89S1 microcontroller. Capacitor C3, resistor R3 and push button switch S1 forms the reset circuitry. Ceramic capacitors C1,C2 and crystal X1 is related to the clock circuitry which produces the system clock frequency. P1.0 to P1.7 pins of the microcontroller is connected to the DB0 to DB7 pins of the module respectively and through this route the data goes to the LCD module. P3.3, P3.4 and P3.5 are connected to the E, R/W, RS pins of the microcontroller and through this route the control signals are transffered to the LCD module. Resistor R1 limits the current through the back light LED and so do the back light intensity. POT R2 is used for adjusting the contrast of the display.

2.3 Comparator

A **comparator** is a device that compares two voltages or currents and outputs a digital signal indicating which is larger. It has two analog input terminals V_+ and V_- and one binary digital output V_o. The output is ideally

$$V_o = \begin{cases} 1, & \text{if } V_+ > V_- \\ 0, & \text{if } V_+ < V_- \end{cases}$$

A comparator consists of a specialized high-gain differential amplifier. They are commonly used in devices that measure and digitize analog signals, such as analog-to-digital converters (ADCs), as well as relaxation oscillators.

IC LM358- LM358 consists of two independent, high gain operational amplifiers in one package. Important feature of this IC is that we do not require independent power supply for working of each comparator for wide range of power supply. LM358 can be used as transducer amplifier, DC gain block etc. It has large dc voltage gain of 100dB. This IC can be operated on wide range of power supply from 3V to 32V for single power supply or from ±1.5V to ±16V for dual power supply and it also support large output voltage swing.

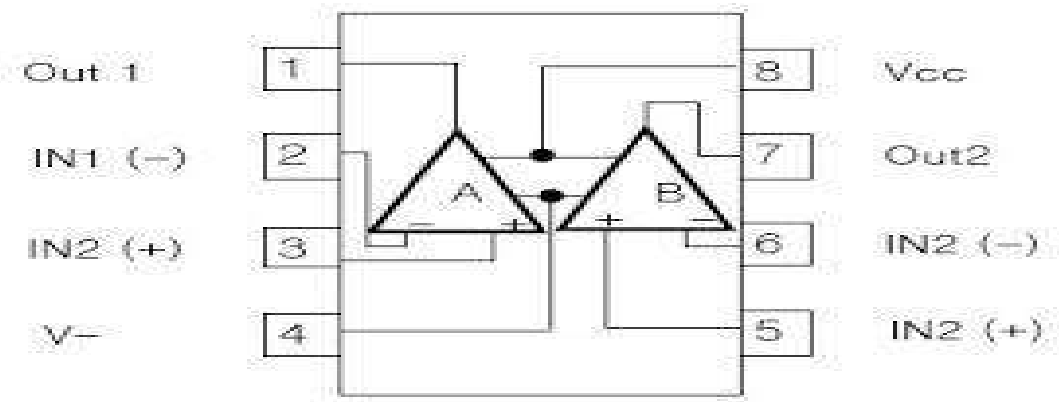


Fig 6: Pin Configuration of IC LM358

From the above figure 6 you can see that operational amplifier has two inputs and one output in one independent LM358. Inputs are at pin 2 (negative pin) and 3 (positive pin), positive pin is used for positive feedback and negative pin is used for negative feedback. In ideal condition when no feedback is applied, gain of the operational amplifier should be infinite. When voltage at pin 2 is more than voltage at pin 3 it will raise the output towards the positive maximum voltage and a slight increase at negative pin compared to positive pin will lower the output towards the negative maximum. This feature of operational amplifier makes it suitable for the purpose of level detection.

2.3.1 Features LM358 Comparator

• Short Circuit Protected Outputs

• True Differential Input Stage

• Single Supply Operation: 3.0 V to 32 V

• Low Input Bias Currents

• Internally Compensated

• Common Mode Range Extends to Negative Supply

• Single and Split Supply Operation

• ESD Clamps on the Inputs Increase Ruggedness of the Device without Affecting Operation

• NCV Prefix for Automotive and Other Applications Requiring

Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable

• These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

2.4 Sensors

The project module employs two sensors namely :

a) IR sensors : Infrared sensors

b) G-sensors: Gravity sensors

2.4.1 IR Sensors

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. By using the IR sensors the eye blink moment is monitored for drowsiness detection. One important point is both IR transmitter and receiver should be placed straight line to each other. The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal. The non inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher then inverting input. Now the comparator output is in the range of +5V. This voltage is given to microcontroller or PC and led so led will glow. When IR transmitter passes the rays to receiver, the IR receiver is conducting due to that non inverting input voltage is lower than inverting input. Now the comparator output is GND so output is given to microcontroller or PC. This circuit is mainly used to for counting application, intruder detector etc.

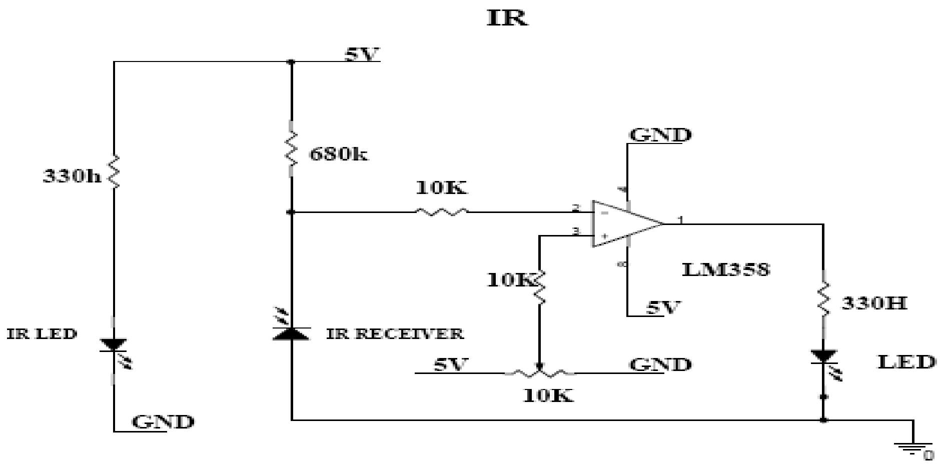


Fig 7 : IR sensor Block diagram

2.4.2 G-Sensors

Gravity sensors are used to stabiles the vehicles , a gravity sensor (G-sensor) mounted on front and rear wheels of the vehicle and generating a signal by detecting the vehicle position is provided in an electronic control unit of the vehicle. The gravity sensor is originated from the 3-axis acceleration sensor. It measures the vector components of gravity when the device is at rest or moving slowly. The gravity sensor can be used, for example, with a game control using tilting motion. In general, the zero point of the G-sensor is set under the assumption that the vehicle is in a horizontal position and then is changed by the traveling state of the vehicle or the state of the road surface, which results in a change in the measurement value of the G-sensor.

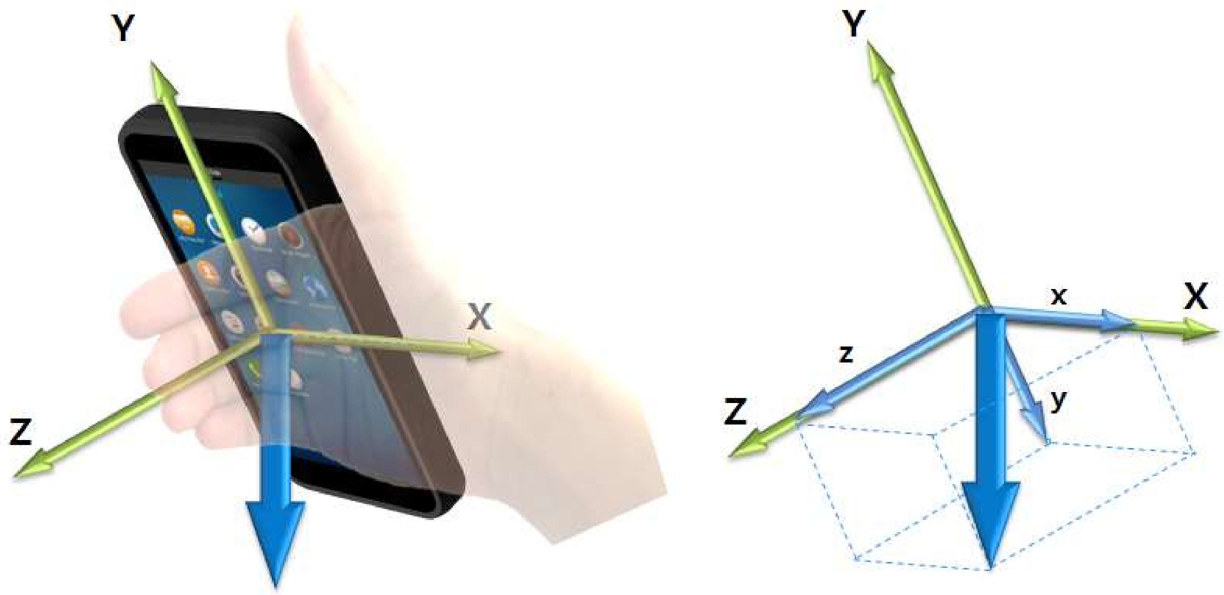


Fig 8 :Coordinates of G-sensors

Gravity is a unit vector (scalar = 1). The gravity sensor outputs 4 values: 3 Cartesian axis values and a timestamp. The gravity sensor measures and returns axes values in "g" (gravity). When a device is accelerated in the ±X, ±Y, or ±Z direction, the corresponding output increases (+) or decreases (-). Acceleration changes generated by gravity are sensed in opposite directions. The G-sensor is widely used in a variety of vehicles, which are commercially available or under development at present, such as hybrid vehicles and fuel cell vehicles as well as internal combustion engine vehicles. Although the application of G-sensors varies depending on G-sensitivity, unidirectional/bidirectional type, and the like, the G-sensors are used in a variety of electronic control systems of the vehicle such as an anti-lock braking system (ABS), an electronic stability program (ESP), an electronic control suspension (ECS), an airbag system, and an anti-rolling control system to detect the vehicle's position, an inclination angle, and a collision. In the above-described application, signals output from the G-sensors are used as an input signal and a reference signal for performing an electronic control logic for the measurement of a yaw rate (using left and right G values), an acceleration rate, an inclination angle (using front and rear G values), and an impact strength, and for the detection of a collision. In more detail, when the vehicle is restarted after being stopped on a slope (“idle stop & go” in an HEV/“stop & go” in a general vehicle), the anti-rolling control system controls the brake system by determining the inclination angle with reference to a signal of the G-sensor during the stop of the vehicle, thus preventing the vehicle from rolling backwards. Moreover, the signals of the G-sensor are used as a collision signal for inflating an airbag in the airbag system, as a reference signal for turning off a main relay of a high-voltage battery during collision of the hybrid vehicle to prevent an electric shock, and as a signal for calculating a target yaw moment as a safety assessment criterion to be compared with a target yaw rate. As such, the G-sensor is a very important sensor used in a variety of systems in the vehicle for a variety of purposes, and when a failure or malfunction occurs in the G-sensor or when the measurement value contains an error, it would be fatal to the safety of the vehicle and passengers.

2.5 Alarm System

When the infrared sensors detect a road boundary line, a 5-volt control signal from the microcontroller that is monitoring the sensors will be sent to a compact 5-volt on board relay. This control signal enables the relay which permits power to be applied to all three driver warning devices.

2.5.1 Audible Alarm

The audible alarm device is a Piezo electric alarm (Figure 9) with approximately a 50 dB level. This audio level will overcome the factory and even most after market stereo system that may be playing at high volume. This alarm is a simple two wire (hot and ground) electronic device that is available from any generic electronics parts vendor. (12V, 80mA)

2.5.2 Visual Alarm

The visual alarm device is a 12-volt flashing LED (Figure 10), with a high visibility lens. It will be mounted near the vehicle's instrument cluster. This LED is a common two lead type LED, and is available at Radio Shack. (12V, 2mA)

2.5.3 Tactile (Physical) Alarm

The tactile alarm (Figure 11) consists of a seat cover with six tiny off balanced motors that are distributed with four motors under the seat and thigh area of the operator and two motors in the lower back area of the operator. These motors will "vibrate" the driver's seat and back areas in a manor that simulates the rumbles strips that are found on some road shoulders. This will help to regain the driver's attention to the road. Our "virtual rumble strips" are essentially a massage vibrator, made by Home Medics, for the seat of a car and is available in markets. (12V, 3A). The vibrating components of the tactile alarm can be incorporated directly into the vehicle seat similar to what some vehicles have today.

The three alarms sound redundant but they serve the useful purpose to alarm three of the five senses thus allowing the driver to react with greater efficiency. NASA space shuttle studies have proven when senses are used in conjunction with each other then the results are faster reaction time. The designed system relies on fast reaction time to be a successful proactive product.

2.5.4 Factors in the decision of the alarm components

The alarm component's scalability, cost, and ergonomics were taken into consideration as deciding factors for our choices in alarm devices. Three of the major components of the alarm system are small and easily mounted with in a car. The LED is .35 inches in diameter and .75 inches long, the 5 volt relay is about 1.5 inches square, and the audible alarm is 2 by 3 inches. These three devices take up a small amount of space and can easily be mounted in the dashboard of the vehicle. The LED, with its high visibility lens, will actually be mounted near the vehicle's instrument cluster so as to be readily seen by the operator since the instrument area is usually the main focal point of the driver. The dB level for the alarm was established at 85 dB so as to alert the driver through an audible tone that will be heard over most car stereo systems at a normal volume level and yet it will not deafen the driver either. The audible alarm will be mounted under the car's dashboard. The wire is comparable to common speaker wire found in most automobiles, and can be wired under the car's dashboard easily. The virtual rumble strips were chosen for their durable construction and vigorous vibrating motors in the locations that we wanted the driver to feel the most (the lower back and seat area).

CHAPTER -3

LITERATURE SURVEY

The literature survey involved study of various research works to understand the associated development in existing technology and their drawbacks. The following research works were taken into consideration while designing the proposed embedded system.

3.1 Reference Papers & Journals:

1. **EFFECTIVE CONTROL OF ACCIDENTS USING ROUTING AND TRACKING SYSTEM WITH INTEGRATED NETWORK OF SENSORS (2013)**

Authors: R. MANOJ KUMAR, DR.R. SENTHIL
DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION,
PANIMALAR ENGINEERING COLLEGE, ANNA UNIVERSITY

International Journal of Advancements in Research & Technology, Volume 2, Issue4, April-2013
69ISSN 2278-7763

Abstract: This Paper is emphasized on road accidents occurring due to Drunk and Drive (Alcohol sensor), inappropriate direction boards, negligence of the driver (sleep deprivation), health anomaly of the driver and enhance the security system of the vehicle. As the fatality rates due to accidents is increasing day by day, the above methods are implemented to decrease the fatality rate. The accidents due to the drowsy state of the driver is prevented using eye blink sensor. Similarly accidents due to the drunken state is prevented using alcohol sensor which detects the alcohol from breath of the driver and stops the engine. The aim is to prevent the accidents by providing receiver unit in vehicles along with transmitter unit at necessary places such as school zones, diversion zones, railway crossings and other accident prone zones to indicate about the respective places well in advance. Vehicles security are mandatory. So here we provide a keypad wherein a security code is set as per the owner’s choice. When someone tries to start the car in the absence of the driver, an alarm which the driver owns will ring. Health anomaly of the driver is conversant through the GSM module.

2. THE RESEARCH ON FATIGUE DRIVING DETECTION ALGORITHM(2013)

Authors: Zhui Lin, Lide Wang, Jieqiong Zhou, Tao Wang
School of Electrical Engineering, Beijing Jiaotong University, Beijing, China

Abstract—Researches on Driver Fatigue Detection System, which aims to ensure the safety of operations and to reduce traffic accidents caused by artificial factors, has been the major research subject in transportation safety. There is an enormous advantage in the method obtaining the driver's image by camera, We propose efficient tracking and detecting algorithm and with an appearance model based on haar-like features, finding out the accuracy and robustness of tracking of eyes movements and the conflict between real time tracing and accuracy of fatigue detection algorithms systems. First, PERCLOS algorithm is adopted to analyze and determine whether a person is fatigue. Second, AdaBoost algorithm is applied to fast detect and the algorithm is implemented in FPGA. Third, We propose a compressed sample tracking algorithm, which compress samples of image using the sparse measurement matrix and train the classification online. The algorithms runs in real time and is implemented based on ARM add FPGA platform. Experimental results show that the algorithm has high recognition accuracy and robust performance under real train driving environment, in the case of non-linear tracking of the human eye, illumination change, multi-scale variations, the driver head movement and pose variation.

3. DISTRACTION DETECTION AND MITIGATION THROUGH DRIVER FEEDBACK (2013)

Authors: John D. Lee, Jane Moeckli, Timothy L. Brown, Shannon C. Roberts, Chris Schwarz, Lora Yekhshatyan, Eric Nadler, Yulan Liang, Trent Victor, Dawn Marshall, Claire Davis
DOT HS 811 547A

Abstract:Despite government efforts to regulate distracted driving, distraction-related fatalities and injuries continue to increase. Manufacturers are introducing real-time driver monitoring systems that detect risk from distracted driving and warn drivers; however, little is known about these systems. This report identifies evaluation techniques to characterize and assess these emerging technologies, presents results of their application, develops a framework for estimating systems' safety benefits, and provides safety relevant information to guide technology development. A standardized language for describing and differentiating systems was created, and its application

revealed key trends in the design landscape. A novel approach to detection that provides prospective indications of safety-critical vehicle state changes is described. Two evaluation protocols were developed and to provide empirical assessments of (1) detection algorithm performance and (2) the effect of mitigations on driver performance and acceptance. The protocol included driving on different types of roadways and performing secondary tasks in the high-fidelity NADS-1 driving simulator. Four progressively complex distraction detection algorithms were compared to evaluate the ability of vehicle-based systems to distinguish between distracted and non-distracted drivers. Algorithm performance varied across road types and distraction tasks. A safety benefits framework appropriate for distraction mitigation systems is proposed that expands on past benefit analyses.

4. A REAL TIME SYSTEM FOR DETECTING DROWSINESS OF DRIVER (2013)

Authors: Puja Malvadkar, Bhavana Pansare & Sachin Pansare
International Journal of Management, InformationTechnology and Engineering (BEST: IJMITE) Vol. 1, Issue 1, Oct 2013

Abstract : According to National Highway Traffic Safety Administration [NHTSA], Drowsiness/sleepiness of driver is oneof the major causes of road accidents. It would, therefore, be both cost and safety beneficial if a drowsiness detection system could be developed. This paper describes a real-time non-intrusive method for detecting drowsiness of driver. It uses webcam to acquire video images of the driver. Visual features like mouth &eyes which are typically characterizing the drowsiness of the driver are extracted with the help of image processing techniques to detect drowsiness. A study about the performance of this proposal & some results are presented**.**

5. DETECTING DRIVER DROWSINESS BASED ON SENSORS (2012)

Authors: Arun Sahayadhas *, Kenneth Sundaraj and Murugappan Murugappan
AI-Rehab Research Group, Universiti Malaysia Perlis (UniMAP), Kampus Pauh Putra, 02600 Arau, Perlis, Malaysia *Sensors* **2012**, *12*, 16937-16953; doi:10.3390/s121216937

Abstract: In recent years, driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries, deaths and significant economic losses. Statistics indicate the need of a reliable driver drowsiness detection system which could alert the driver before a mishap happens. Researchers have attempted to determine driver drowsiness using the following measures: (1) vehicle-based measures; (2) behavioral measures and (3) physiological measures.

A detailed review on these measures will provide insight on the present systems, issues associated with them and the enhancements that need to be done to make a robust system. In this paper, we review these three measures as to the sensors used and discuss the advantages and limitations of each. The various ways through which drowsiness has been experimentally manipulated is also discussed. We conclude that by designing a hybrid drowsiness detection system that combines non-intusive physiological measures with other measures one would accurately determine the drowsiness level of a driver. A number of road accidents might then be avoided if an alert is sent to a driver that is deemed drowsy.

6. SLEEPY DRIVING IN TRUCK DRIVERS: INSIGHTS FROM A SELF-REPORT SURVEY (2011)

Authors: Raymond Misa, Russell Conduit and Grahame Coleman
HFESA 47th Annual Conference 2011. *Ergonomics Austral*

Abstract: There is increasingly more evidence to indicate that many Australian truck drivers may be working while sleepy. However, relatively little is known about their sleepiness-related experiences or why sleepy drivers continue to drive. Aims: This study examined the subjective experience of sleepiness and the motivation of truck drivers at work, with particular focus on the behaviour of persevering with driving despite being sleepy. Method: Two hundred and fifty-five Australian professional truck drivers (245 males, 10 females, mean age of 43.60 years, average of 19.11 years experience) completed a self-report survey that was distributed at Australian truck stops and transport organisations. Drivers were asked to report on a variety of sleepiness-related experiences during the previous three months of their work. Results: The results revealed that 49% of drivers felt too sleepy to drive on at least half of their trips, while 40% reported falling asleep while driving at least once in the previous three months of work. A regression analysis indicated that several psychosocial factors were related to sleepy driving behaviour (i.e. continuing to drive when sleepy). These included impaired judgement, perceived work and social pressures, driver attitudes, and, most notably, perceived lack of control over work schedule. The frequency of sleepy driving was also associated with reported occurrences of impaired driving performance, dozing off whilst driving, near misses, and perceived accident risk. Conclusions: These findings provide new direction for further investigations of truck driver attitudes and behaviour, as well as the management of driver sleepiness.

7. CONTROLLED INDUCEMENT AND MEASUREMENT OF DROWSINESS IN A DRIVING SIMULATOR. (2010)

Authors: Helios De Rosario,a* José S. Solaz,a Noelia Rodríguez,b Luis M. Bergasac
doi:10.1049/iet-its.2009.0110)

Abstract : This paper presents a study of driver drowsiness, looking for patterns in biomedical and biomechanical variables that allow characterizing the drowsiness cycle, and detecting its phases with new technologies. Biomedical signals, eye closure, pressures on the seat, and longitudinal and lateral control of the vehicle have been recorded in a driving simulator, during a test in an environment that induced drowsiness, while subjects were motivated to struggle against sleep. 20 volunteers were measured during 1 h 45 min tests. A control signal that combined EEG and eye closure (PERCLOS) was defined to classify the different states of the participants during the test. According to that standard, drowsiness was successfully induced in 80% of the subjects. The changes in those states influenced both the performance of the driving task and the biomedical signals, although the former were less sensitive to early fatigue. Heart Rate Variability and respiration turned out to be promising indicators of the state of the driver, that can be used in future drowsiness detection systems.

8. REAL-TIME NONINTRUSIVE DETECTION OF DRIVER DROWSINESS (2009)

Author: Xun Yu
Department of Mechanical and Industrial Engineering University of Minnesota Duluth

Abstract :Driver drowsiness is one of the major causes of serious traffic accidents, which makes this an area of great socioeconomic concern. Continuous monitoring of drivers' drowsiness thus is of great importance to reduce drowsiness-caused accidents. This proposed research developed a real-time, nonintrusive driver drowsiness detection system by building biosensors on the automobile steering wheel and driver's seat to measure driver's heart beat signals. Heart rate variability (HRV), a physiological signal that has established links to waking/sleepiness stages, is analyzed from the heat beat pulse signals for the detection of driver drowsiness. The novel design of measuring heat beat signal from biosensors on the steering wheel means this drowsiness detection system has almost no annoyance to the drivers, and the use of a physiological signal can ensure the drowsiness detection accuracy.

9. AUTOMATIC RECOGNITION OF VIGILANCE STATE BY USING A WAVELET-BASED ARTIFICIAL NEURAL NETWORK (2005)

Authors: Abdulhamit Subasi, M. Kemal Kiymik , Mehmet Akin & Osman ErogulSpringer-Verlag London Limited 2005 Neural Comput & Applic (2005) 14: 45–55DOI 10.1007/s00521-004-0441-0

Abstract : In this study, 5-s long sequences of full-spectrum electroencephalogram (EEG) recordings were used for classifying alert versus drowsy states in an arbitrary subject. EEG signals were obtained from 30 healthy subjects and the results were classified using a wavelet based neural network. The wavelet-based neural network model, employing the multilayer perception (MLP), was used for the classification of EEG signals. A multilayer perception neural network (MLPNN) trained with the Levenberg–Marquardt algorithm was used to discriminate the alertness level of the subject. In order to determine the MLPNN inputs, spectral analysis of EEG signals was performed using the discrete wavelet transform (DWT) technique. The MLPNN was trained, cross-validated, and tested with training, cross-validation, and testing sets, respectively. The correct classification rate was 93.3% alert, 96.6% drowsy, and 90% sleep. The classification results showed that the MLPNN trained with the Levenberg–Marquardt algorithm was effective for discriminating the vigilance state of the subject.

10. EEG-Based Drowsiness Estimation for Safety Driving Using Independent Component Analysis (2005)

Authors: Chin-Teng Lin*, Fellow, IEEE*, Ruei-Cheng Wu, Sheng-Fu Liang, Wen-Hung Chao, Yu-Jie Chen, and Tzyy-Ping Jung
IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—I: REGULAR PAPERS, VOL. 52, NO. 12, DECEMBER 2005

Abstract: Preventing accidents caused by drowsiness has become a major focus of active safety driving in recent years. It requires an optimal technique to continuously detect drivers' cognitive state related to abilities in perception, recognition, and vehicle control in (near-) real-time. The major challenges in developing such a system include: 1) the lack of significant index for detecting drowsiness and 2) complicated and pervasive noise interferences in a realistic and dynamic driving environment. In this paper, we develop a drowsiness-estimation system based on electroencephalogram (EEG) by combining independent component analysis (ICA), power-spectrum analysis, correlation evaluations, and linear regression model to estimate a driver's cognitive state when he/she drives a car in a virtual reality (VR)-based dynamic simulator. The driving error is defined as deviations between the center of the vehicle and the center of the cruising lane in the lane-keeping driving task. Experimental results demonstrate the feasibility of quantitatively estimating drowsiness level using ICA-based multistream EEG spectra. The proposed ICA-based method applied to power spectrum of ICA components can successfully (1) remove most of EEG artifacts, (2) suggest an optimal montage to place EEG electrodes, and estimate the driver's drowsiness fluctuation indexed by the driving performance measure. Finally, we present a benchmark study in which the accuracy of ICA-component-based alertness estimates compares favorably to scalp-EEG based.

11. DRIVER ATTENTION DETECTION SYSTEM (DADS) (2002)

Author : Mathew Parks
U.S. DEPARTMENT OF TRANSPORTATION SMALL BUSINESS INNOVATION RESEARCH PROGRAM SOLICITATION NO. DTRS57-02-R-SBIR

Abstract: The Driver Attention Detection System (DADS) is a proactive infrared line detection device that warns drivers of erratic or inattentive driving behavior. This is accomplished by the use of federally required road line implementation on 45+ mph rated primary or interstates highways. Using six low cost off-the-shelf infrared sensors and receivers the DADS system will proactively detect any change in road color other the normal grayscale such as yellow, white or red dictated by DOT road line standards. Coupled with a next-to-real-time processing interface and a total processing time standard of 1/200-second the DADS uses basic comparison, checking and verification algorithms to detect the swerving and erratic behavior of persons exhibiting drowsy, inattentive behavior. The whole system will be completely unobtrusive, concealed, have no user interaction, and low installation cost but most importantly will save lives. This system relies on simple, cost effective standards that exist already and is constructed using proven technology and software. DADS is a breakthrough using existing technology to solve the second leading cause of fatal accidents in the United States and the largest leading cause of death in the trucking industry.

3.2 Gaps in Literature

1. Majority of accident prevention technology take response after accident occurrence, causing delay in emergency response and could not be prevented.
2. From the literature review carried out it is found that dependence/load on Satellite services for tracking and locating (GSM and GPS) could be shared by smart grids but cannot be eliminated.
3. Standardized technologies governing IOT are not well defined on very large scale. Prominent standardization bodies, such as the IETF, IPSO Alliance and ETSI, are working on developing protocols, systems, architectures and frameworks to enable the IOT services.
4. With demand for portable electronic products, there is a need to design devices that could be accessed anytime in case of emergency.
5. It is required to enable the emergency services for quick response during road accidents.
6. It is required to initiate advanced connectivity services that goes beyond machine to machine communication and covers variety of protocols, domains & application.
7. It is required to establish devices that are Automatic, Intelligent and Responsive
8. Drowsiness effects cannot be studied alone in simulator situations due to variation in monotony environment.
9. Understanding behavioural model of drowsiness combined with the psychological model can enable development of accurate technology for drowsiness detection.
10. Use of EEG technology, wavelet transformation, and image detection comes with limitation of uncomfortable wearable sensors and inability of camera & sensors to detect dark skinned people using the safety device

3.3 Future Enhancement

1. The device prototype formulated can be made portable by making its ability to work on mobile charging sockets in car, such that aesthetics of the vehicles are left undisturbed.
2. For more accurate data a 3-axis accelerometer can be interfaced with the device for accurate drowsiness measurement.
3. Easy updates for software module can be constructed to provide support for smartphones, applications and other internet capability devices.
4. The growth of smart grids can lead to replacement of the GSM module placed in the prototype by a wireless router or a WiFi enabled device.
5. The prototype measures drowsiness via a headgear, for actual real time application, the headgear can be replaced by sensors mounted over the dashboard of the vehicle.
6. The interface design for various vehicles can be simplified through rapid prototyping of model formulated.
7. Sensor information's can be mitigated over the cloud networks through a software algorithm for easy assessment of accident causes and conditions.

CHAPTER -4

AIMS & OBJECTIVES OF PROPOSED PROTOTYPE

This project prototyped is aimed to design & implement uniquely identifiable embedded computing devices within existing internet infrastructure for night vehicle drivers to locate and prevent road accident caused due to drowsiness. The objectives of proposed model are summarized below :

I. Establish an eye blink & head movement monitoring sensor system for Drowsiness detection.

II. In case of drowsiness detected

  a) alert the driver via a wake call (vibration /Buzzer)

  b) reduce speed and stabilize vehicle

III. Display the activities of designed system on LCD display.

IV. Mediate the Sensor information and locate accident location using GPRS for rescue.

4.2 Problem Statement

The problem statement includes improving the quality of data acquisition about distraction-related crashes along with better analysis techniques. By analysing and understanding of the extent and nature of the distraction problem. The main aim is to reduce the driver workload associated with performing tasks using both built-in and portable in-vehicle devices via limiting the visual and manual demand associated with in-vehicle device interface designs. Better device interfaces and integrated wearable computers will help to minimize the amount of time and effort involved in a driver performing a task using the device. Minimizing the workload associated with performing non-driving, or “secondary,” tasks with a device enables the driver to maximize the attention they focus toward the primary task of driving. Keep drivers safe through the introduction of crash avoidance technologies. These include the use of crash warning systems to re-focus the attention of distracted drivers as well as vehicle initiated (i.e., automatic) braking and steering to prevent or mitigate distracted driver crashes. Educate drivers about the risks and consequences of distracted driving are performed by targeted media messages, drafting and publishing laws.

4.3 Need For project Prototype

The following are the motivating factors that determines the need for the development of the project prototype:

1. To develop a standard specification template to describe distraction detection and mitigation systems
2. With demand for portable electronic products, there is a need to design devices that could be accessed anytime in case of emergency.
3. It is required to enable the emergency services for quick response during road accidents.
4. To initiate advanced connectivity services that goes beyond machine-to-machine communication and covers variety of protocols, domains & application
5. To establish device systems that are Automatic, Intelligent and Responsive.
6. Provide a safety benefits framework for estimating the overall effect on driving safety
7. Develop alternative distraction detection and distraction mitigation design concepts.

4.4 Methodology

The Block diagram of proposed prototype consists of the following Components :

1. LCD Display
2. Drowse Sensors (IR sensors)
3. LM358 Comparator
4. NXP RD25 (8051 Microcontroller)
5. Vibrator
6. Engine Speed Controller
7. Analog to Digital Converter (ADC)
8. Gravity Sensors (3- axis accelerometer)
9. GSM & GPRS Module (Mobile phone)

10. Power Supply (12V 2Amp. DC+ SMPS)

The above components are integrated as per the block diagram given in Fig 1. The designed embedded system is interfaced with another mobile phone having an android platform through an IOT application. Such an application is designed on an android platform and it provides notification to the host about the status of embedded system in case of drowsiness and accident occurrence via alarms, text messages and voice notifications.

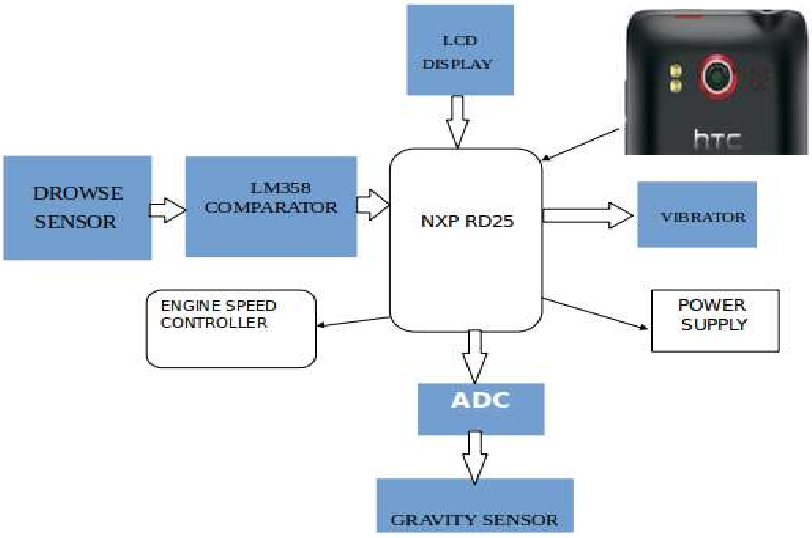


Fig.9 Block diagram of implemented prototype

DESCRIPTION:

The process of working of above block diagram is explained as follows.

This project involves measurement of eye blink using IR sensor and head movement using accelerometer. The IR transmitter is used to transmit the infrared rays in our eye. The IR receiver is used to receive the reflected infrared rays of eye. If the eye is closed then the output of IR receiver would be high ,otherwise the IR receiver output is low. To know whether the eye is in closing or opening position. The output is provided to a logic circuit for alarm indication and status will displayed on LCD display. Accelerometer is placed on driver fore-head it measures tilt angle of the drivers in vertical either forward or backward direction and left or right direction from the driver knee. If tilting angle exceeds certain threshold range, This output is give to logic circuit to indicate the alarm and status is displayed on LCD.

Monitoring Eye movement:

By monitoring the eye of a human being, we can determine whether he/she is sleeping or not. One common technique of monitoring eye blink rate is by measuring infrared (IR) light reflected from the surface of the eye. The eye is illuminated by an IR LED, which is powered by the +5V power supply and the reflected light is recorded by an IR photo diode. The IR photo diode converts this reflected light into electrical signal and given to Op-Amp. The output of Op-Amp

Depending on the intensity of light received by the IR photo diode, micro-controller drives the buzzer according to output of Op-Amp. The digital display provides various messages to the user. When the eye is open, maximum amount of light will be reflected from the eye because our eyeball is transparent, while minimum of light will be reflected from the eye, when it is closed as skin part of eye is opaque.

Monitoring Head movement:

Head movement detection is done through single step Accelerometer eg: ADXL330 which measures 3-axis detection. It consists of angle based accelerometer (ACC) input to simulate accurate head movement. For the movement analysis, it

is needed to somehow translate the tilt angle data to displacement of mouse cursor that is calculating new head position. There are two main methods when calculating the new head cursor position:

1. Absolute mapping in which every tilt angle corresponds to a position on screen.
2. Relative mapping in which every tilt angle corresponds to a head displacement amount (step size) and this amount is summed by the coordinates of the head's old position, to calculate new position

4.5 GANTT Chart

Work	Jan				Feb				Mar				Apr				May				June			
Activity weeks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Pre-Project Presentation																								
Literature Review																								
Identification of Application and Design Specifications																								
Identification of suitable Architecture																								
Development and Simulation of FinFet based SRAM cell																								
Interim Review																								
Creation of Test Environment																								
Preparation of Draft Copy for final Dissertation																								
Final Presentation																								
Submission of poster, publication and Final																								

CHAPTER-5

DESIGN FLOW

5.1 P89v51rd2 Microcontroller

The main centre part of the project is the microcontroller. Here we are using the 8051 based Philips P89V51RD2 microcontroller. The P89V51RD2 are 80C51 microcontrollers with 64kB flash and 1024 B of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (six clocks per machine cycle) to achieve twice the throughput at the same clock frequency. The flash program memory supports both parallel programming and in serial ISP. Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible.

5.1.1 Features

I. 80C51 CPU with 5V operating voltage from 0 to 40 MHz

II. 64 kB of on-chip flash user code memory with ISP and IAP.

III. SPI and enhanced UART.

IV. Four 8-bit I/O ports with three high-current port 1 pins.

V. Three 16-bit timers/counters.

VI. Programmable watchdog timer.

VII. Eight interrupt sources with four priority levels.

VIII. Second DPTR register

IX. Low EMI mode (ALE inhibit)

X. TTL- and CMOS-compatible logic levels

XI. Brownout detection

XII. Low power modes

A. Power-down mode with external interrupt wake-up

B. Idle mode

5.2 Block Diagram

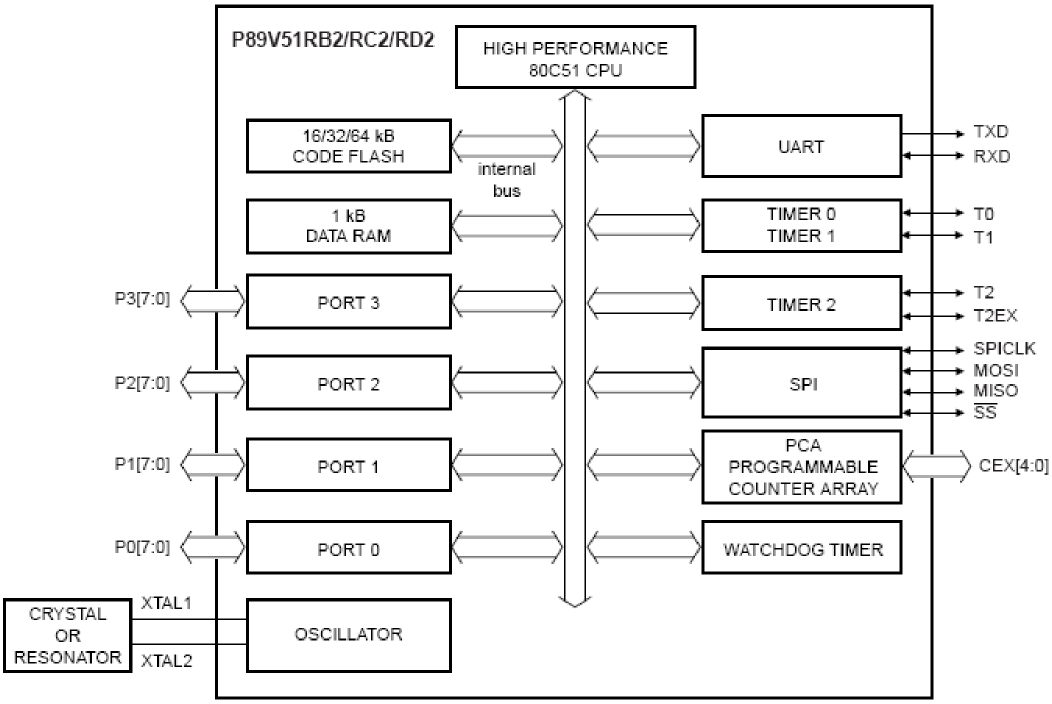


Fig 10 : Block Diagram of P89v51rd2 Micro-Controller

5.3 Memory Organization

There are two internal flash memory blocks in the device. Block 0 has 16/32/64 kb and is organized as 128/256/512 sectors, each sector consists of 128 B. Block 1 contains the IAP/ISP routines and may be enabled such that it overlays the first 8 kB of the user code memory. The data RAM has 1024 B of internal memory. The device can also address up to 64 kB for external data memory.

The device has four sections of internal data memory:

1. The lower 128 B of RAM (00H to 7FH) is directly and indirectly addressable.

2. The higher 128 B of RAM (80H to FFH) are indirectly addressable.

3. The special function registers (80H to FFH) are directly addressable only.

4. The expanded RAM of 768 B (00H to 2FFH) is indirectly addressable by the move external instruction (MOVX)

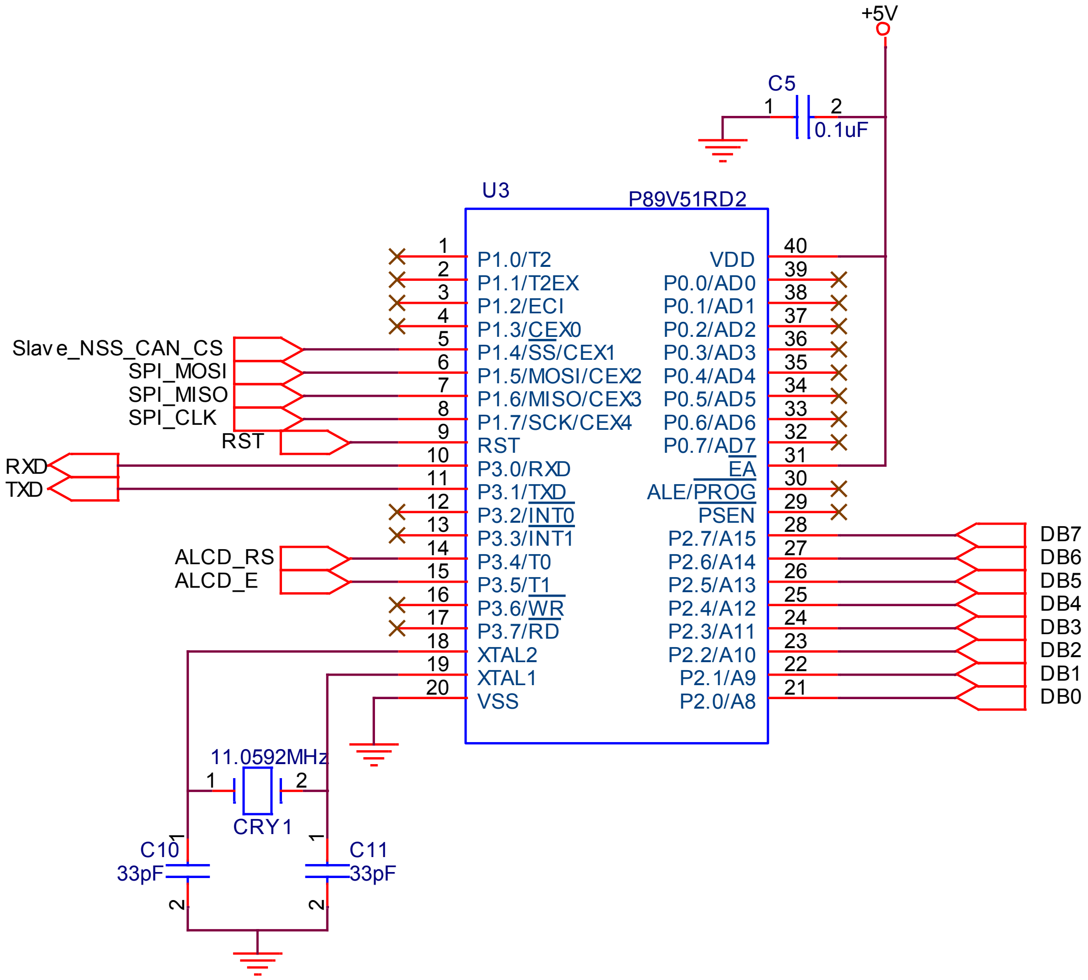


Fig 11 : P89v51rd2 Ports and Pin configurations

5.4 PORTS

a) PORT 0

PORT0 is an 8-bit open drain bi-directional I/O PORT. As output PORT, each pin can sink eight TTL inputs. When are written to PORT0 pins, the pins can be used as high impedance inputs. PORT0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. PORT0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

b) PORT 1

PORT1 is an 8-bit bi-directional I/O port with internal pull-ups. The PORT1 output buffers can sink/source four TTL inputs. When logic 1s are written to PORT1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, PORT1 pins that are externally being pulled low will source current because of the internal pull-ups. PORT1 also receives the lower order address bytes during flash programming and verification. In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX).

c) PORT 2

PORT2 can also be used as an 8-bit bi-directional I/O PORT with internal pull-ups. The PORT2 output buffers can sink/source four TTL inputs. When ones are written to PORT2 pins, they are pulled high the internal pull-ups and can be used as inputs. As inputs, PORT2 pins that are externally being pulled low will source current because of the internal pull-ups. The alternate use of PORT 2 is to supply a high order address byte in conjunction with the PORT0 low order byte to address external memory. It uses strong internal pull-ups when emitting ones. It also receives the higher order address bytes and some control signals during flash programming and verification.

d) PORT 3

PORT3 is an 8-bit bi-directional I/O PORT with internal pull-ups The PORT3 output buffers can sink/source four TTL inputs. When ones are written to PORT3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, PORT3 pins that are externally being pulled low will source current because of the pull-ups. PORT3 also serves the functions of various special features of the AT89C51, as shown below

Port	Configuration	Details
P3.0	RXD	(serial input port)
P3.1	TXD	(serial output port)
P3.2	INT0	(external interrupt 0)
P3.3	INT1	(external interrupt 1)
P3.4	T0	(timer 0 external input)
P3.5	T1	(timer 1 external input)
P3.6	WR	(external data memory writes strobe)
P3.7	RD	(external data memory read strobe)

Table 4: Port Configuration of P89v51rd2

e) Timers

The two 16-bit Timer/counter registers: Timer 0 and Timer 1 can be configured to operate either as timers or event counters. In the ‘Timer’ function, the register is incremented every machine cycle. Thus, one can think of it as counting machine cycles. Since a machine cycle consists of six oscillator periods, the count rate is 1¤6 of the oscillator frequency. In the ‘Counter’ function, the register is incremented in response to a 1-to-0 transition at its corresponding external input pin, T0 or T1. In this function, the external input is sampled once every machine cycle. When the samples show a high in one cycle and a low in the next cycle, the count is incremented. The new count value appears in the register in the machine cycle following the one in which the transition was detected. Since it takes two machine cycles (12 oscillator periods) for 1-to-0 transition to be recognized, the maximum count rate is 1/12 of the oscillator frequency. There are no restrictions on the duty cycle of the external input signal, but to ensure that a given level is sampled at least once before it changes, it should be held for at least one full machine cycle. In addition to the 'Timer' or 'Counter' selection, Timer 0 and Timer 1 have four operating modes from which to select. The 'Timer' or 'Counter' function is selected by control bits C/T in the Special Function Register TMOD. These two Timer/counters have four operating modes, which are selected by bit-pairs (M1, M0) in TMOD. Modes 0, 1, and 2 are the same for both Timers/counters. Mode 3 is different. The four operating modes are described in the following text.

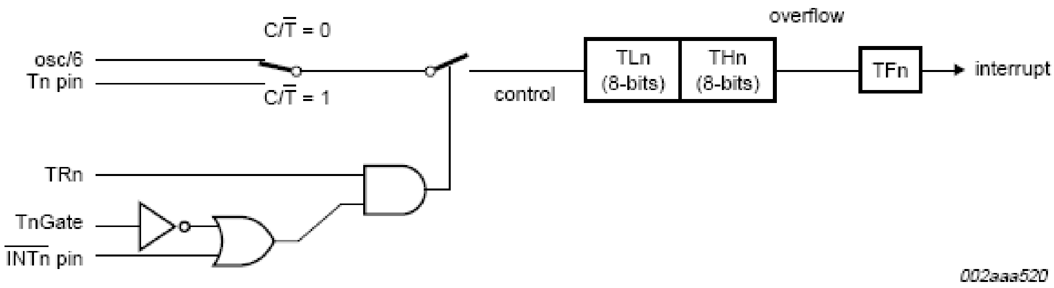


Fig 12: modes of operation

f) UARTS

The UART operates in all standard modes. Enhancements over the standard 80C51 UART include Framing Error detection, and automatic address recognition.

5.5 GSM

SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz. SIM300 features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. You can use AT Command to get information in SIM card. The SIM interface supports the functionality of the GSM Phase 1 specification and also supports the functionality of the new GSM Phase 2+ specification for FAST 64 kbps SIM (intended for use with a SIM application Tool-kit).Both 1.8V and 3.0V SIM Cards are supported. The SIM interface is powered from an internal regulator in the module having nominal voltage 2.8V. All pins reset as outputs driving low.The "AT" or "at" prefix must be set at the beginning of each command line. To terminate a command line enter <CR>. Commands are usually followed by a response that includes."<CR><LF><response><CR><LF>". Throughout this document, only the responses are presented, <CR><LF> are omitted intentionally. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership.

5.6 GSM COMMANDS

AT+CBC	Request module battery state.	
AT+CBC? AT+CBC=? AT+CBC AT+CBC=1	<n> 0: battery not in charge 1: battery in charge 2: battery full 3: battery low <m> 0: battery level 0 25: battery level 1 50: battery level 2 75: battery level 3 100: battery level 4	+CBC: n,m OK +CBC: (0-3), (0-100) OK +CBC: n,m OK +CME ERROR 3 Note: not support
AT+CGMI	This command gives the manufacturer identification.	
AT+CGMI Note: Get manufacture identification AT+CGMI=? AT+CGMI? AT+CGMI=1		FLYFOT MODEM OK Note: Command valid, FLYFOT modem OK +CME ERROR 3 Note: not support
AT+CPAS	This command returns the activity status of the mobile equipment.	
AT+CPAS Note :Current activity status AT+ CPAS?	**<pas>** 0: ready (allow commands from TA/TE) 1: unavailable (does	+CPAS: <pas> OK +CME ERROR 3

AT+ CPAS=? AT+ CPAS=1	not allow commands) 2: unknown 3: ringing (ringer is active) 4: call in progress 5: asleep (low functionality)	Note: not support
AT+CMGS= <address> <CR>	The <address> field is the address of the terminal to which the message is sent. To send the message, simply type, <ctrl-Z>	
AT+CMGS=.28.<CR> 0031000BA13105119226F40000AD0AA8C3F6 30885E9ED301 <ctrl-Z>		+CMGS: <mr> OK Note : Successful transmission
AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr>	This command selects the procedure for message reception from the network.	
AT+CNMI=2,1,0,0,0 Note : <mt>=1 AT+CNMI=2,2,0,0,0 Note : <mt>=2 AT+CNMI=2,0,0,1,0 Note : <ds>=1 AT+CNMI=2,0,0,0,0 Note : <ds>=0	**<mode>**: controls the processing of unsolicited result codes **Important note: only <mode>=2 is supported.** **<mt>**: sets the result code indication routing for SMS-DELIVER indications. **<bm>**: defines the rules for storing the received CBMs (Cell Broadcast Message) types. **<ds>** for SMS-STATUS-REPORTs. Default is 0. **<bfr>** Default is 0.	OK Note: message received and saved in sim, then route the SMS-DELIVERS with unsolicited result codes: +CMTI: SM, <index> OK Note: message received, then route the SMS-DELIVERS with unsolicited result codes: +CMT: [<alpha>,] <length> <CR> <LF> <pdu> OK Note: SMS-STATUS-REPORTS are routed using unsolicited code: +CDS : <length> <CR> <LF> <pdu> OK Note: No SMS-STATUS-REPORTs are routed. +CNMI: 2,2,0,1,0

at+cnmi? Note : Read at+cnmi=?		Will return the previous status. +CNMI: (0-3),(0-3),(0-3),(0-1),(0,1)
AT+CMGR=<index>	This command allows the application to read stored messages	
AT+CMGR=1 Note : Read the message		+CMGR: 1,,24 0891683108100005F0040D91683185716393 F9000050014290428023 04B0182C06 OK
AT+CMGL=<stat>	This command allows the application to read stored messages, by indicating the type of the message to read. **Does not work.**	**<stat>** possible values received unread messages(0) received read messages(1) stored unsent messages(2) stored sent messages(3) all messages(4)
AT+CMGS= <address> <CR>	The <address> field is the address of the terminal to which the message is sent. To send the message, simply type, <ctrl-Z>	
AT+CMGS=.28.<CR> 0031000BA13105119226F40000AD0AA8C3F6 30885E9ED301 <ctrl-Z>		+CMGS: <mr> OK Note : Successful transmission

Table 5 :GSM Commands

Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is loaded. It requires Windows 95/98/ME/NT/2000/XP operating system.

5.6 General commands for GSM

Manufacturer identification +CGMI

Description: This command gives the manufacturer identification.

Syntax: Command syntax: AT+CGMI

Command	Possible responses
AT+CGMI Note: Get manufacture identification	FLYFOT MODEM OK Note: Command valid, FLYFOT modem
AT+CGMI=?	OK
AT+CGMI? AT+CGMI=1	+CME ERROR 3 Note: not support

Table 6:syntax manufacturer identification+CGMI

a) New message indication +CNMI

Description: This command selects the procedure for message reception from the network.

Syntax : Command syntax : AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr>

Command	Possible responses
AT+CNMI=2,1,0,0,0 (default value) Note : <mt>=1	OK Note: message received and saved in sim, then route the SMS-DELIVERS with unsolicited result codes: +CMTI: SM, <index>
AT+CNMI=2,2,0,0,0 Note : <mt>=2	OK Note: message received, then route the SMS-DELIVERS with unsolicited result codes: +CMT: [<alpha>,] <length> <CR> <LF> <pdu>
AT+CNMI=2,0,0,1,0 Note : <ds>=1	OK Note: SMS-STATUS-REPORTS are routed using unsolicited code: +CDS : <length> <CR> <LF> <pdu>
AT+CNMI=2,0,0,0,0 Note : <ds>=0	OK Note: No SMS-STATUS-REPORTs are routed.
at+cnmi? Note : Read	+CNMI: 2,2,0,1,0
at+cnmi=?	+CNMI: (0-3),(0-3),(0-3),(0-1),(0,1)

Table 7:New message identification+CNMI

C) Send message +CMGS Description : The <address> field is the address of the terminal to which the message is sent. To send the message, simply type, <ctrl-Z> character (ASCII 26). The text can contain all existing characters except <ctrl-Z> and <ESC> (ASCII 27). This command can be aborted using the <ESC> character when entering text. In PDU mode, only hexadecimal characters are used (‘0’…’9’,’A’…’F’).

Syntax : Command syntax in PDU mode :

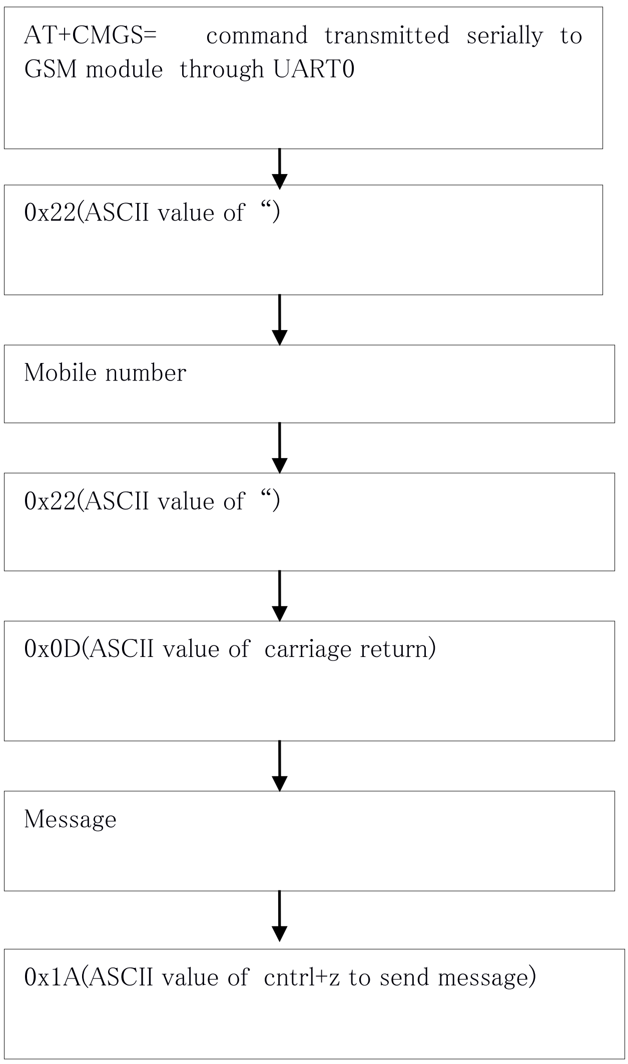
AT+CMGS= <length> <CR>   PDU is entered <ctrl-Z / ESC >

Command	Possible responses
AT+CMGS=28<CR> 0031000BA13105119226F40000AD0AA8C3F6 30885E9ED301 <ctrl-Z> Note : Send a message in PDU mode	+CMGS: <mr> OK Note : Successful transmission
AT+CMGS=?	+CMGS: OK
AT+CMGS AT+CMGS?	+CMS ERROR: 3 Note: not supported.

Table 9 :command syntax in pdu mode

The message reference, <mr>, which is returned to the application is allocated by the product. This number begins with 0 and is incremented by one for each outgoing message (successful and failure cases); it is cyclic on one byte (0 follows 255).

GSM_Send_SMS Flow chart



5.7 Alpha-Numeric Lcd Display

A liquid crystal display is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. In liquid crystal displays (LCDs) of liquid crystal technology is the most common applications. An advanced VGA computer screen from the pervasive wrist watch and pocket calculator, this type of display has evolved into an important and ambidextrous interface. Consist of a liquid crystal display, an array of tiny segments (called pixels) and to present the information that can be manipulated. This basic common idea is to all displays, alienate from simple calculators to a full color LCD television. The primary factor was size, an LCD consisting of primarily with some liquid crystal material between them of two glass plates. There is no bulk amount picture tube. This gives LCDs practical for applications where size (as well as weight) is necessary. In general, LCDs uses very low power than the cathode-ray tube (CRT) counterparts. Many LCDs are ruminative, means that they use only atmosphere light to illuminate the display. Even displays that do consume much less power than CRT devices require an external light source (i.e. computer displays)

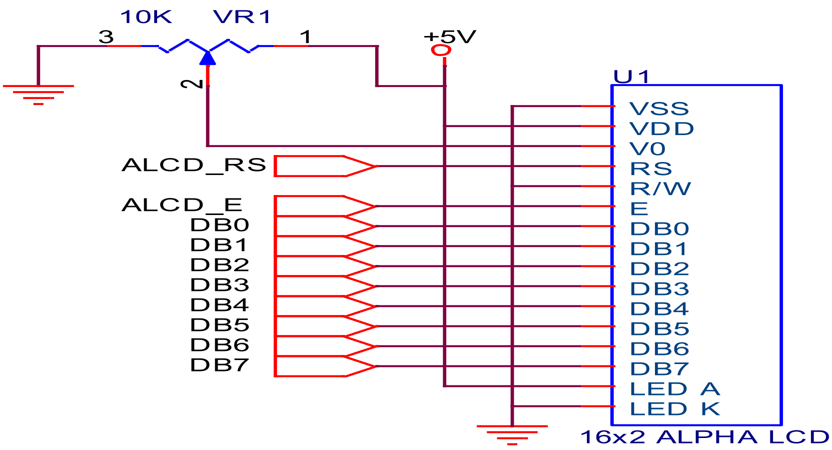


Fig 13 : LCD internal structure

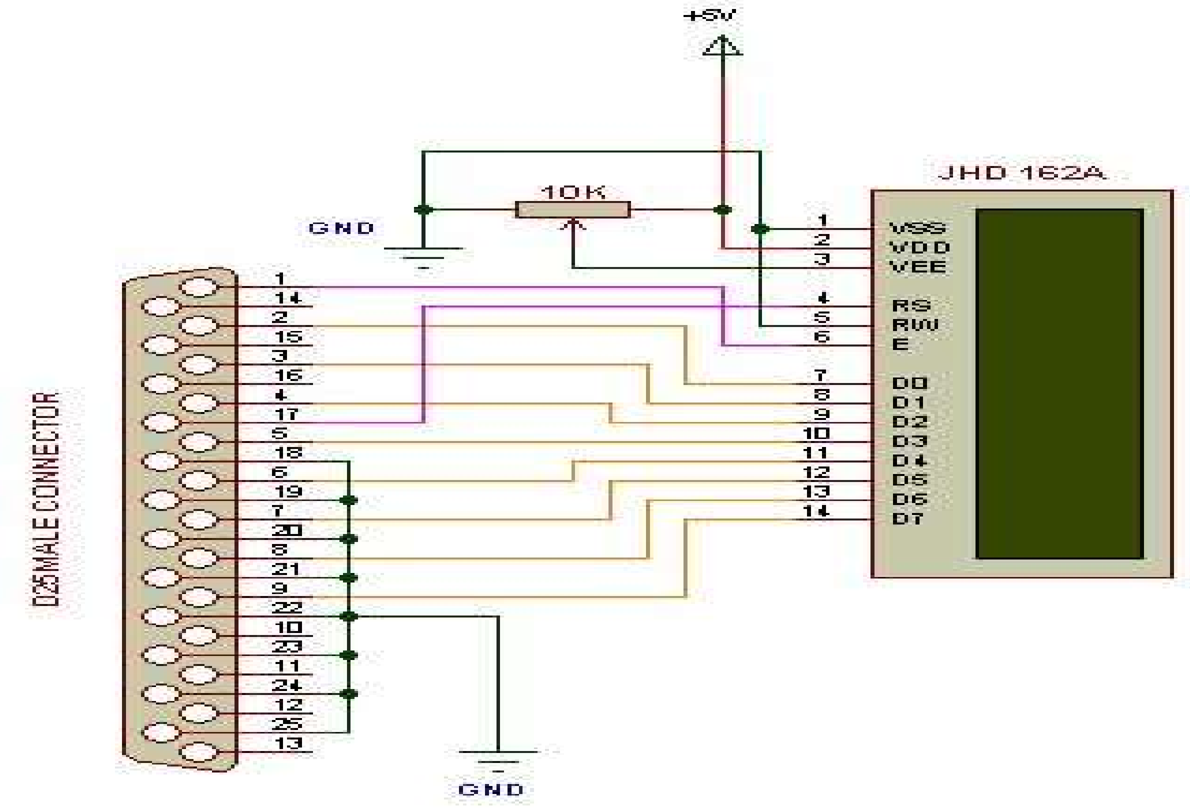


Fig 14 : D25 Male connecter interface with LCD

Pin NO.	Symbol	Level	Description
1	VSS	0V	Ground
2	VDD	5.0V	Supply voltage for logic
3	VO	---	Input voltage for LCD
4	RS	H/L	H : Data signal, L : Instruction signal
5	R/W	H/L	H : Read mode, L : Write mode
6	E	H, H → L	Chip enable signal
7	DB0	H/L	Data bit 0
8	DB1	H/L	Data bit 1
9	DB2	H/L	Data bit 2
10	DB3	H/L	Data bit 3
11	DB4	H/L	Data bit 4
12	DB5	H/L	Data bit 5
13	DB6	H/L	Data bit 6
14	DB7	H/L	Data bit 7
15	LED A(+)	4.2V	Back light anode
16	LED K (-)	0V	Back light cathode

Table 10 : LCD Voltage levels

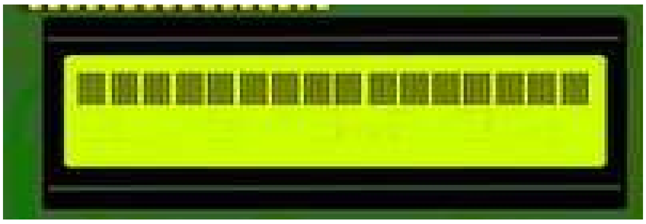


Fig 15 : Typical 16 X 2 LCD

Make sure that 5V and GND lines are properly connected otherwise you may end up in damaging parallel port. If you want backlight than connect pin 15 of LCD to 5V and pin 16 of LCD to GND. By adjusting 10k resistor make pin 3 of LCD at 0V. If connections are proper you will see this after power on.

a) LCD initialization

void ALCD_Init(void)

ALCD_Comm(0x0E); This command will make the display on, cursor blinking

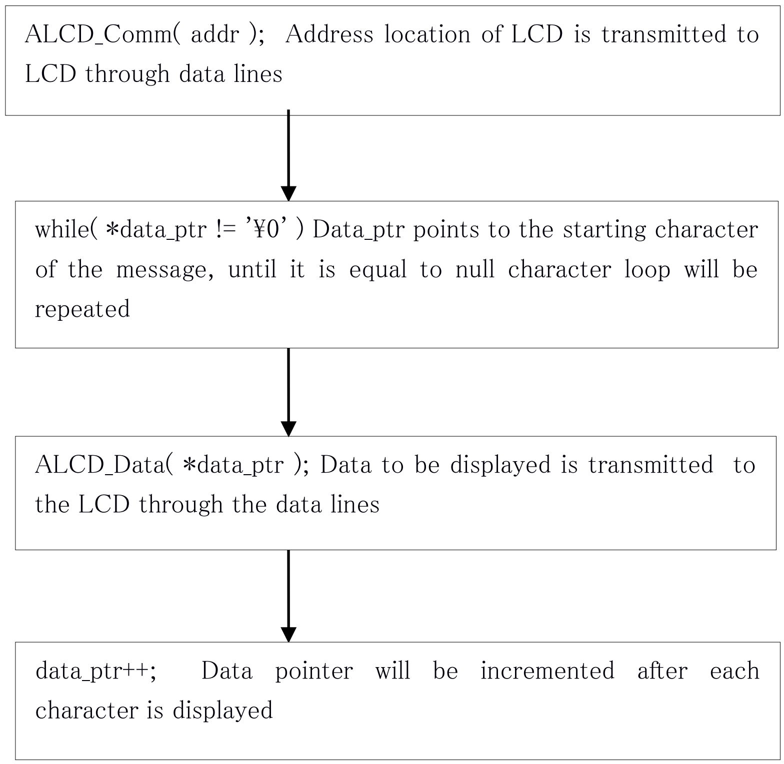
ALCD_Comm(0x01); This command will clear the LCD display

ALCD_Comm(0x06); This command will shift the cursor to right

Flow chart 2: LCD Initialization

a) LCD message function

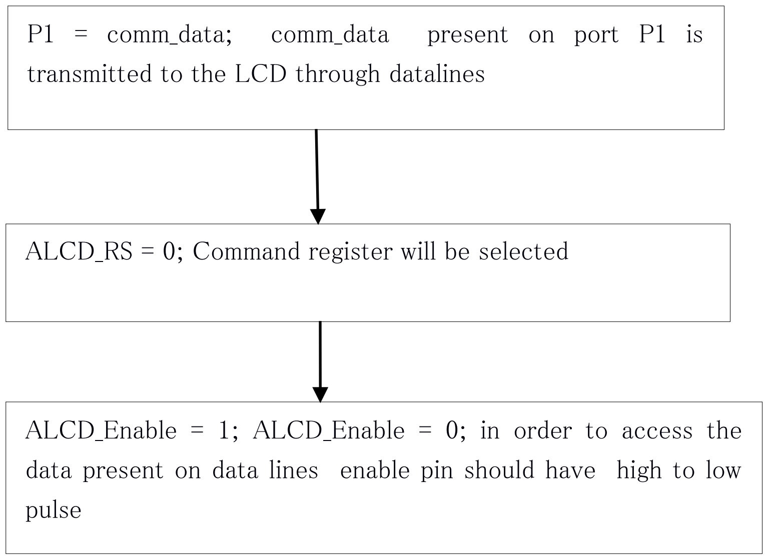
void ALCD_Message(unsigned char addr, unsigned char *data_ptr)



Flow Chart 3 : LCD message function

a) LCD command function

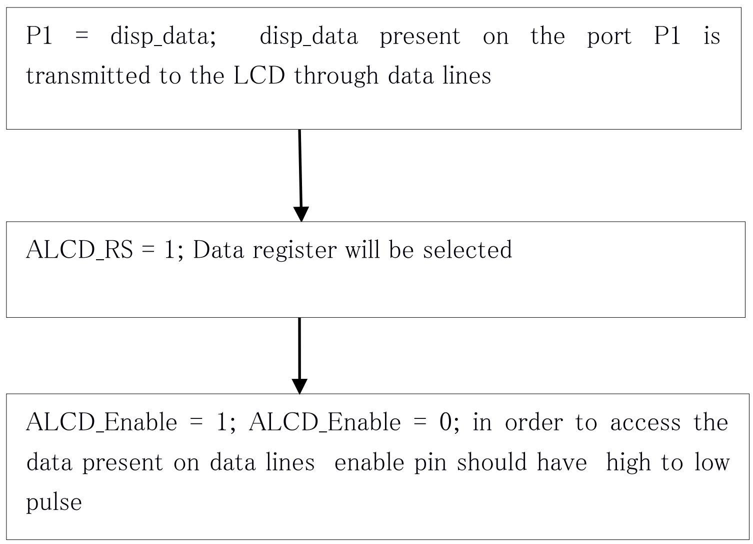
void ALCD_Comm(char comm_data)



Flow Chart 4 : LCD command function

a) LCD data function

void ALCD_Data(char disp_data)



Flow Chart 4 : LCD Data Function

CHAPTER -6

Results

The following conclusions can be made from the following proposed prototype :

1. The subject (night drivers) drowsiness can be effectively measured based on eye blink monitoring system.
2. If drowsiness is detected then automatic responses from designed embedded system is possible such as alarm and reducing the speed of vehicle.
3. In case of accident occurrence the designed system is equipped with the capability of sending response messages to the host android device by means of an IoT enabled application. The response messages are in form of voice and text notifications.
4. The GSM module involved in the designed system is used to effectively track the location of the vehicle. The location of vehicle and nearby emergency service facilities are effectively displayed on the portable android devices of host device and embedded device through Google Maps.

Fig 16:Designed system

Fig 16: Desgined system

Fig 17:IR sensor & accelerometer

Fig 18: Normal eyeblink message on LCD

Fig 19: Drowsiness detected message on LCD

Fig (a) depicts the designed hardware for drowsiness detection and Fig (b) indictes the two sensor inputs into the designed embedded system. The drowsiness of driver is detected based on the threshold values on IR sensor and accelerometer and the corresponding results are shown on LCD screen mounted on the hardware. At the same time the required response in terms of physical alarm (viberation) and text messages are sent over IoT android application to intimidate driver and host emergency response in respective case of initial drowsiness and accident occurrence.

Fig (c) and Fig (d) indicates the LCD messages displayed during response of drowsiness detection conditions. In case of normal eye-blink LCD Screen displays the voltage recorded during opening and closing of eyelids. While in case of drowsiness LCD screen Shows “Sleeping” message and initiates the physical alarm.

CHAPTER- 7

Conclusions and Future works

Majority of portable devices are aimed at providing unlimited access to internet services for data storage and synchronization with other remote devices. Hence, there is a need of faster data acquisition and quick decision making of embedded computing system for real time applications for making vehicles safe, automatic, responsive and intelligent. Interfacing of simple sensors to various micro-controller platforms enables the ease of regulating the embedded system at a sophisticated levels of automation and mediating the sensor information over a smart grid enables large amount of data acquisition for taking accurate decisions over the emergency conditions. Further, the development of smart grids fascinates the overall process of communication between human and machine rather than machine to machine communication. Hence, IoT can revolutionize the way embedded systems interact and respond for variety of applications especially in case of vulnerable night drivers by monitoring the state of their drowsiness for a quick, safe and effective response for a safer road travel.

7.1.1 Features of the proposed prototype

The following are the exclusive features provided by the designed prototype :

8. Solution for drunkards when they are over drunk wake them when they are drowsing
9. Solution for night drivers when they feel sleepy while driving overnight to wake them up
10. Solution for rash driving , cut the speed by stoping the spark to the starter or sparkplug & wake them up
11. Solution for wheel grip using gravity sensor
12. Advice for drivers by their loved ones when they are overdrunk or rash driving
13. Solution for preventing accidents
14. Solution for detecting accidents using impact sensors

15. Tracking & locating the location of accident using GPS

7.1.2 Advantages

1. The methodology aims at preventing accident before it's occurrence hence, increases the safety of both person driving the vehicle and other people on roads.
2. Involvement of Cloud computing reduces the load on satellite services (GPS and GSM) and are easily implementable
3. Assists emergency services and quick response teams to take quick action in case of occurrence.
4. Enables implementation of effective safety regulations for four-wheel drive on roads at both day and night.
5. User friendly interface enable it's easy usage by vehicle drivers.
6. Gravity sensors prevents over speeding of vehicles and maintains vehicle stability.
7. Fast growth in Smart grid and cloud services makes it effective and easy implementation

7.1.3 Disadvantages

1. The device requires an active internet connection.
2. For implementation over a smart grid network, security issues such as terror attacks aimed at disrupting emergency services are yet to be resolved.
3. Diverse applications call for different deployment scenarios and requirement are needed , which, are usually proprietary i.e IOT technology is very new with less application based companies that grew very fast over a span of two years.
4. Prominent standardization bodies, such as the IETF, IPSO Alliance and ETSI, are required on developing protocols, systems, architectures and frameworks to enable the IOT

7.1.4 Applications

1. Solution for Night drivers to wake them from drowsiness caused due to sleeplessness.
2. Prevention of Accident caused due to Substance abuse (Alcohol, Drugs, etc)
3. Solution for rash driving by automatically controlling the vehicle speed
4. Vehicle stability by maintain a better wheel grip through gravity sensors.
5. Tracking and locating the location of accident using GPS and plotting it on Google maps

7.1.5 Future Enhancements in Proposed Embedded System

The following future enhancement can be made into proposed system by devising software algorithms, hardware implantations and interfacing sensors :

1. Solution for drink and drive cases.
2. Solutions for emergency speed control of vehicles.
3. Solution for rash driving by obstructing Spark-plug.
4. Solution for wheel grip using gravity sensor.
5. Voice based real time advice for drivers by their loved ones when they are over-drunk Or Rash-driving.
6. Solution For Preventing Accidents.
7. Solution For Detecting Accidents Using Impact Sensors.
8. Global Photos Transfer Using GPRS In Arm 11 Device And Mailing It To Required People.

7.1.6 Future Enhancements in Internet of Things (IoT)

The IoT inferences can make the sensors sensible enough to rectify the whole process which in turn will move towards making the whole process intelligent. The components that make up the WSN monitoring network include:

• Wireless Sensor Networks hardware - Typically a WSN node contains interfaces to sensors, computing and processing units, transceiver units and power supply. More sophisticated sensor nodes can communicate over multiple frequencies

• Wireless Sensor Networks Communication Stack (WSNCS) – The nodes will be deployed in an adhoc manner. Communication topology will be an important factor for communication through the system of WSN nodes. There is this communication stack at one central node which will be able to interact with the connected world through the Internet and which will act as a gateway to the WSN subnet and the Internet .

• Middleware–This is associated with the internet infrastructure and the concept of service oriented architecture (SOA) for access to heterogeneous sensor resources as described in. WSNs technological advances in hardware domain catering to circuits and wireless communications have made robust and cost effective devices in sensing applications. This has led to the use of sensors in wireless communication devices in diversified environments. Sensor data is collected and sent for centralized, distributed or any hybrid processing module for data processing. Hence, there are several challenges WSN has to face to develop a successful IoT communication networks.

I. Challenges in IoT Applications

a. Communication Mechanism- 6lowpan Challenges

All the objects that are present in the environment can be called object fit to be the "things" of the internet. All these objects need an address which must be unique. This uniqueness property will be a unique constraint and it will pave the way to gather information and even control sensor based devices. Internet Protocol is the standard based protocol which is used for internetworking methods of Internet. The first version was IPv4 and was thought of having huge address spaces. But IPv4 got exhausted. smart embedded devices or simply a sensor. Their communication mechanisms will be Wi-Fi, DSL, Satellite, Cable, Ethernet and so forth. The typical packet size of the communicating protocol will be around 1500 data bytes to 9000 data bytes and even more. Today large amount of spatial data is also being generated and thus we can use to use metadata for connecting database and Internet. As happens in World Wide Web, the operations with sensor nodes may not be possible by giving unique names to the sensors. Instead a unique address scheme must be formulated and will be known as Unique Resource Name (URN).A look up table of these URN must be present at the centralized node commonly known as gateway to the sensor sub system. Thus entire network now forms a web of connectivity from users (high-level) to sensors (low-level) that is addressable (through URN) accessible (through URL) and controllable (through Uniform Resource Characteristics - URC)

• Data Storage - As IoT is getting developed the amount of data getting created is huge. The data centers which will be storing this data will also needs space requirement as well as the energy and power resources. It is this data which needs to be organized and processed. Semantic

data fusion models will also be required to create meaning out of this data. Artificial Intelligence algorithms must be applied to extract meaning from this redundant data. Data storage and analysis will be a challenge when the whole world will be connected through IoT.

• Visualization - Any interaction of user with the environment will need proper visualization software which will highlight the sensing mechanism as well the interpretation of data scenario too. Touch screens and smart embedded tablets have created a conductive environment for the system. The information which is being processed in to meaningful data using sensor fusion

algorithms will present lot many inferences about the current situation.

II. Scope Of IoT Services And Applications

Let us look into the possible set of future possibilities which we can have a rewarding applications. Some of the attributes which can be considered while developing application is highlighted in which says the network availability, bandwidth, area of coverage, redundancy, user involvement and impact analysis. Fig.7 mainly focuses on the properties of the RFID, sensors and 6lowpan communication networks based IoT services.

a. Tracking: People, Inventory and Logistic

The basis of this tracking is indeed RFID tags which are placed on object, human beings, animals, logistics etc. RFID tag reader may be used in all the intermediate stages for tracking anything which has the RFID tag in it. This object position identification can be smartly used to trigger an alarm, event or a specific inference regarding a specific subject.

b. Smart Environment and Enterprise Collection

In any work environment an enterprise based application can come up with the fact that it is based on smarter environment. Here the individual or the enterprise may give data to outside world on its own discretion. Smart embedded sensor technology can be used in order to monitor and transmit critical parameters of the environment. Common attributes of the environment are temperature, humidity, pressure etc. Smart monitoring of soil parameters can allow informed decision making about agriculture and increase production of food grains and prevent loss of crops . Water conservation is huge topic of concern where droughts are frequent. To limit water wastage, smart technology can be used in water conservation.

c. Smart Unit

Another IoT application which is making waves is the Smart grid and smart metering technology. The energy consumption can be efficiently monitored in a smart home or in a small office or even a locality. This model can be extended over a city for better load balancing. The world is fast changing and now camera based surveillance is high in demand. This surveillance will not only require image processing but also computer vision. IoT which will be based on video processing is a new technological challenge to integrate large computation with small embedded device. Smart homes can be developed where things of daily use will be tracked using sensor enabled technologies.

d. Local, Global and Social Sensing

Imagine a scenario where each of the family members of the family have a RFID enabled gadget and thus object tracking can result actually in human tracking. This can readily happen in IoT where common mobile phones can be used for tracking human beings. There can be various types of sensors based devices which can be used for such type of tracking. This is whole process is known as local, global and social sensing. The object can be tracked locally, globally and in any place, any time and over any network.

e. Healthcare Monitoring Applications

Imagine a scenario in a village where old age persons, infants, pregnant ladies etc. have RFID enabled chips over their bodies to track their vital health parameters. Any unusual activity on their part will raise an alarm or an alert in the nearby local medical assistance home. For example, RFID chips can be implanted in patients in order to track their medical history. Sensor technology can be used in emergency response, and health monitoring applications. The information can be used to give medical assistance to the needful person and in case of higher abnormalities, the nearby efficient hospitals can be alerted and thus the hospitalization costs can be reduced through early intervention and treatment. This is the advantage of smart healthcare using IoT.

f. Traffic Monitoring

In any city in the world, traffic monitoring is an important part of the smart-city infrastructure. Normal traffic to highway traffic all requires adequate information about the support and logistics available on the highway and in turn the system can be made self-reliable and intelligent. Any type of congestion on roads will ultimately lead to loss of fuel and economic loss. Any foresight on traffic will always help to improve the whole system. With number of WSN and Sensor enabled communications, an IoT of traffic will be generated. This will be known as Traffic IoT (TIoT). The information collected from TIoT can be presented to travelers. The traffic information will be dependent upon the queuing model on roads and infrastructure of roads itself.

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