MULTI SENSOR FUSION BASED VEHICLE TRACKING SYSTEM

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\textbf{ABSTRACT:} The paper is about vehicle tracking system. Generally, transport plays an important role in everyday life. The goods are carried from the warehouse to the market via road transport. This vehicle tracking system provides information on the current location using GPS and the elevation angle of the vehicle is measured using accelerometer. The distance and time required to reach the destination is calculated and if the distance and time is constantly increasing, then it is assumed that the vehicle did not reach the location and the vehicle gets locked by disabling the motors. The data is transmitted from the vehicle to the owner via GSM as an SMS. The data from GPS and accelerometer is fused by Kalman filter to improve accuracy.

\textbf{Key Words:} GPS, GSM, Accelerometer, Kalman filter, vehicle tracking.

I. INTRODUCTION
An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, store and also to control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the output within the time limits. Embedded systems support to make the work more perfect and convenient. So, frequently embedded systems are used in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc. The embedded system generally consists of sensors which transmit the data at real time basis and the transmitting module which transmits the data. The processor processes the data and follows the instruction in order to perform a particular task.

Generally, a vehicle tracking system consist of a GPS receiver and a transmitting module with the receiver end. The receiver end may be a hand device like mobile phones or the webpages etc.

The existing proposed system uses GPS and Accelerometer values directly. The proposed system fuses the data of the GPS and accelerometer values and stabilizes it using an algorithm and transmits the data via GSM.

II. COMPONENTS REQUIRED
The hardware components used are:
\begin{itemize}
  \item GSM module
  \item Accelerometer
  \item GPS receiver module
  \item Arduino UNO
\end{itemize}

The software components used are:
\begin{itemize}
  \item Arduino IDE
  \item MATLAB
\end{itemize}

A. GSM module
GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.
TDMA technique relies on assigning different time slots to each user on the same frequency. It can easily adapt to data transmission and voice communication and can carry 64kbps to 120Mbps of data rate.

**B. Accelerometer**

An accelerometer is a device that measures acceleration. The acceleration due to gravity and the actual measurement of the accelerometer is different.

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright. Accelerometers are used in drones for flight stabilization. Coordinated accelerometers can be used to measure differences in proper acceleration, particularly gravity, over their separation in space; i.e., gradient of the gravitational field. This gravity gradiometry is useful because absolute gravity is a weak effect and depends on local density of the Earth which is quite variable.

Micromachined micro electromechanical systems (MEMS) accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input.

**C. GPS Receiver module**

A GPS navigation device, GPS receiver, or simply GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device’s geographical position. Using suitable software, the device may display the position on a map, and it may offer directions. The Global Positioning System (GPS) is a global navigation satellite system (GNSS) made up of a network of a minimum of 24, but currently 30, satellites placed into orbit by the U.S. Department of Defense.

The GPS was originally developed for use by the United States military, but in the 1980s, the United States government allowed the system to be used for civilian purposes. Though the GPS satellite data is free and works anywhere in the world, the GPS device and the associated software must be bought or rented.

A GPS device can retrieve from the GPS system location and time information in all weather conditions, anywhere on or near the Earth. A GPS reception requires an unobstructed line of sight to four or more GPS satellites, and is subject to poor satellite signal conditions. In exceptionally poor signal conditions, for example in urban areas, satellite signals may exhibit multipath propagation where signals bounce off structures, or are weakened by meteorological conditions. Obstructed lines of sight may arise from a tree canopy or inside a structure, such as in a building, garage or tunnel.
D. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

Revision 3 of the board has the following new features: 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

III. IMPLEMENTATION

The block diagram of the proposed system is given below.

The block diagram consists of GPS receiver and accelerometer whose data needs to be fused. The data is fused using kalman filter. The fused data is sent serially to the ARDUINO UNO which processes the data to the GSM module. The GSM Module sends a SMS every 30 seconds to the registered user with the latitude and
longitude values. Accident detection can also be indicated to the user if the elevation angle is detected to be in out of range.

The above figure is the flow chart of Kalman Filter algorithm. In statistics and control theory, Kalman filtering, also known as linear quadratic estimation (LQE), is an algorithm that uses a series of measurements observed over time, containing statistical noise and other inaccuracies, and produces estimates of unknown variables that tend to be more accurate than those based on a single measurement alone, by estimating a joint probability distribution over the variables for each timeframe.

The Kalman filter has numerous applications in technology. A common application is for guidance, navigation, and control of vehicles, particularly aircraft and spacecraft.

The algorithm works in a two-step process. In the prediction step, the Kalman filter produces estimates of the current state variables, along with their uncertainties. Once the outcome of the next measurement (necessarily corrupted with some amount of error, including random noise) is observed, these estimates are updated using a weighted average, with more weight being given to estimates with higher certainty. The algorithm is recursive. It can run in real time, using only the present input measurements and the previously calculated state and its uncertainty matrix; no additional past information is required.

**IV. EXPERIMENTATION AND RESULT**

![Fig.7: The working model of the proposed system](image)

![Fig.8: Vehicle location received as SMS](image)
The GPS receiver, accelerometer sensor and GSM module is connected to the ARDUINO board as shown in Fig 7 and the location is sent to the mobile phone as a SMS with specific location as shown in Fig 8. The alert message on accident along with the location of occurrence is also received as a SMS.

V. CONCLUSION AND FUTURE WORK

In this proposed system, GPS receiver and Accelerometer sensor are used to get the location of the vehicle and its elevation angle. The data is fused and sent it to ARDUINO UNO which processes the data and send it to GSM Module which sends it to the mobile phone of the owner. The future work includes the interfacing of camera with ARDUINO to capture the image of the person who is driving it.

VI. REFERENCES

6. P.S. Mistary, R.H. Chile, "Real time vehicle tracking system based on ARM7 GPS and GSM technology", Annual IEEE Indian conference (INDICON), 2015.