

# Cloud Based Child Tracking System Using Raspberrypi

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**Abstract:** *In recent times there is sudden increase in cases of child kidnapping, missing child, and child harassment. It is observed that children's security in school buses and outside school premises is questionable. This proposed system tries to ensure best possible safety of children using smart features which are additions in existing tracking system for better security. The proposed system consists of school bus unit, school unit and android application. The School-Bus Unit will note presence of child in bus using RFID .GPS module attached to this unit will track location and bus speed constantly. Alcohol sensor and tampering switch in this unit provide secured transport to child. Cloud connectivity and live video streaming facility is provided by Raspberry pi unit which act as slave controller to AVR in bus unit. The School Unit identifies the child in school using RFID scan and update child location on server using WIFI module. The Android Application is an user interface for getting the information of the child and the exact location of the bus.*

**Keywords:** Alcohol Sensor, Global positioning system, RFID, Raspberry Pi, Security, Wi-Fi(ESP 8266)

## 1. Introduction

Recently, all over the world, crime against children is increasing at higher rates and it is high time to offer safety support system for the children going to schools[1]. School buses are under pressure to provide a safe, reliable service to school children and their parents. It is observed that most of child harassment and kidnapping cases occurred in school bus and in vicinity of school area[2][3][4]. Most of the school buses don't have enough facility for children security. School premises lack surveillance and are vulnerable for crime cases thus sending a child to school by bus can be nerve wracking for parents.

Children Tracking system is widely used all over the world to assure parents that their wards are safe from suspicious actions. Thus we need smart child tracking system which will track child's movement from home to school and vice versa. There are various technologies available in today's world for child security and each one has its limitation and usefulness. However the existing systems are not powerful enough to prevent the crime against children since resulting in low assurance about their child safety to parents. The idea of this project is to develop more safe and smart system than existing systems. After analyzing various current child tracking systems we try to make systems more reliable and avoid faults in existing system. We added some new features to existing system for making it more effective.

The proposed system includes tracking the child's movement to and from school. The RFID scanning module plays very important role in our system. As soon as child enters in school bus RFID module scans identity of the child and send signal to microcontroller. Microcontroller then uses signal for status update of child location on android application using internet connection provided by raspberry pi. Global positioning system (GPS) module on bus helps to provide exact location coordinates of school bus which are sent to the android application through internet by controller. In similar way RFID modules keeps on updating child status whenever child passes through it that is entering and leaving school bus

and school. Along with this constant tracking using RFID raspberry pi on school bus unit serves additional purpose of live video streaming which can be observed on server by parents or school officials. The proposed system also have additional features such as alcohol sensor for alcohol detection by driver, tampering protection switch for keeping school bus module intact and GPS module provide speed information of school bus in order to prevent rash driving. In school module updated status by RFID module is sent to android application by using WIFI module. WIFI module provides internet connection.

Thus by using two different modules we try to track child at every position outside home. Along with constant tracking for maintaining reliable security we added video streaming option which is very trustful option for child security. We have selected raspberry pi here as it provide both internet connection and video processing capability in an efficient and cheap way as compared to other modules.

Separate school unit and alcohol sensor are unique features of this project which is important for the child security as it ensures better child tracking. Android application in this system plays important role for easy and quick user interaction. Thus we try to implement system which is smart as well as cost effective.

## 2. Related Works

After a brief review, we found out that few current systems in the market focuses on the different security and tracking aspects. This includes of two terminals. First terminal is parent smartphone and second one is child smartphone. In this system both terminals uses smart features of mobile like GPS and GSM. Parent terminal can request send request to child terminal for the location updates. Listener running in the back round services of the child terminal reads the request SMS and will reply the latest coordinates from the satellite or the network provider[5]. This proposed system captures location of the child using GPS and the coordinates are transferred to the mobile terminals via GSM. There panic

button provided at the base terminal in order to alert parent via mobile terminal. PIC microcontroller manages all the interfaces at the base terminal [6]. It is arm7 based child tracking system. In this system GPS tracks the location of the child and inform it to the parents through GSM and android app. This system also has unique feature of voice chip with speaker. Similar type of system is implemented using Arduino board presented in different paper [7]. This system includes arm controller along with GPS, GSM. It also includes voice detecting circuit, temperature sensor and accident detection switch for additional security. Tracking server tracks location and safety of child on bus and provide it to the parents [8][9].

Project implemented using Arm7 (lpc2378). Project tracks child using GPS and status will reach to parents android phone via Ethernet. GSM unit will provide data to monitoring unit at school. Moving child to two receivers. When the child cries, voice playback circuit is triggered by ARM7 microcontroller and intimation about corresponding child is given through text message to their parents [10]. This is a smart application which uses Raspberry pi board as a controller. In this project raspberry pi fetches position coordinates from GPS module by using NMEA protocol. Raspberry pi sends this coordinates to the web server using Ethernet. Broad band connection is needed for raspberry pi to provide Ethernet connection. Webserver uses MySQL database to store coordinate information. Android device request web server to provide current location of the child and displays it on the Google map [11]. The system contains passive RFID module. Each child has given a unique RFID tag attached to his bag. When child enters or leaves the school bus RFID module scans the child tag and make note of it. It uses GPRS technology for Ethernet connection in school bus and WIFI connection at school unit for marking child's entry and exit in a school on web server. Back end server manages the web server records. The proposed system also includes different decision algorithms for safety purpose such as decision making algorithm and alert management algorithm. This algorithm alerts system if child is left behind or in wrong bus [12]. We also got few idea from the current project undertaken by the government for tracking school buses, which provides the exact location of the bus. It also provides the arrival and the departure timings of the buses along with driver details [13]. This bus tracking system is another smart system which includes school bus tracking and bus attendance. It also includes features like speed alert, live video streaming, emergency management system, voice calling, pickup drop sms, bus engine status and driver identification [14]. Northstar is a comprehensive child safety platform. It leverages the best in Geo-technology to provide an end-to-end school bus tracking and child monitoring solution. Northstar, a product from Magnasoft, leverages GPS, RFID and Video surveillance technology, coupled with a cloud-enabled software platform. This is so far best working application we found included with all safety features mentioned above. [15] There are many more systems available that are used to track the location of the child or person or any kind of objects. [16][17][18][19]. These systems had few drawbacks and also required a compiled system that will provide every possible aspect of the child and the location. The project we aim to implement provides video streaming in cost effective way. We try to provide

smart security in terms of alcohol sensor and tampering protection. Thus our project will replicate certain features in already implemented systems with maximum possible efficiency.

#### A. System Design Concept And Working

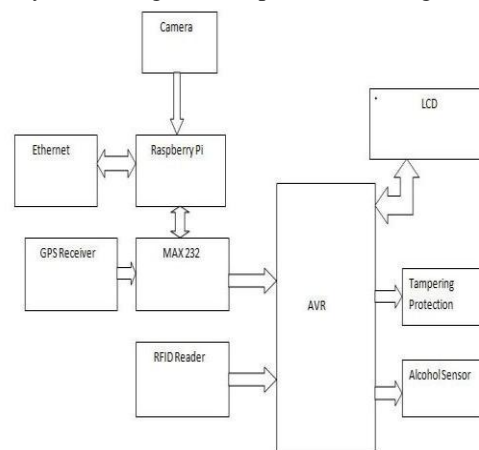


Fig1 Bus unit

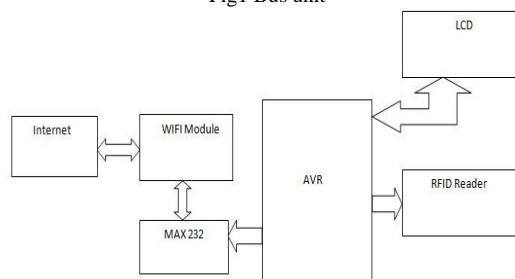


Figure 10: School unit

There are three units in project

##### 1) School bus unit

This unit is responsible for identifying entry and exit child in school bus and notifying the parents. Also this unit has GPS module which keeps track of school bus. This unit is interfaced with camera through raspberry pi thus it provides facility of live video streaming. Alcohol sensor and tampering protection provides additional security to the child

##### 2) School unit

This unit marks the entry and exit of child in school and notifies to the parents on android application by Wi-Fi module.

##### 3) Android application

This application helps parents and school staff to keep watch on children by locating their position and school bus position. This application also watches on safety of children.

## 3. Hardware System Design

### 3.1 ATmega32

The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.



Figure 3: ATmega32

### 3.2 GPS (GR 301)

A low cost water resistant (IPx7) GPS receiver/antenna (smart antenna or GPS Mouse) for automatic vehicle location (AVL) and vehicle tracking. The GR301 Smart GPS Receiver is designed based on SiRF Star III Architecture. It communicates with the mobile data terminals via RS232 and a USB adaptor is available for connection to other devices. With low power consumption, the GR-213 tracks up to 20 satellites at a time, re-acquires satellite signals in 100 ms and updates position data every second. It has baud rate of 4800 bps and sensitivity of -159dbm. It needs power of around 3.3- 5.5 v for working and temperature operating range is 40 – 85 degrees.



Figure 4: GPS module (GR301)

### 3.3 Wi-Fi Module (ESP 8266)

ESP 8266 offers a complete self contained Wi-Fi networking solution . It can be used to host the application or to offload Wi-Fi networking functions from another application process. When the module hosts the application it boots up directly from the external flash. It has integrated cache to improve the performance of the system. Alternately serving as a Wi-Fi adaptor, wireless internet access can be added to any micro controller design with simple connectivity (I2C, UART, SPI, SDIO).

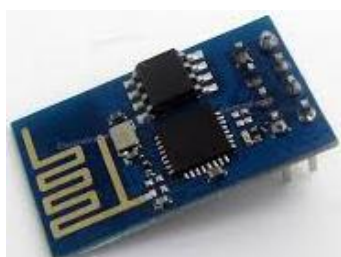


Figure 5: WIFI module (ESP 8266)

This module has integrated low power 32 bit CPU integrated 10bit ADC integrated TCP/IP protocol stack . It also has low Standby power consumption of < 1.0mW (DTIM3)

### 3.4 RFID (KR 100)

Radio Frequency Identification (RFID) uses electromagnetic fields to automatically identify the tags attached to the objects. The tags contain the electronically stored information. The passive tags collect the energy from nearby RFID reader's interrogating radio waves. Active tags have the local power source such as battery and may operate at hundreds of meters from RFID reader. Unlike the barcode tags, the tags may not be within the line of sight of the reader, so it may be embedded in the tracked object.



Figure 6: RFID module (KR100)

#### Features

- Verification Distance: Up to 10cm
- Built-in Card Reader: 125kHz RFID proximity reader
- Communication: Wiegand Output

### 3.5 Alcohol Sensor (MQ3 series)

The sensitive material of MQ-3 gas sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. When the target alcohol gas exists, the sensor conductivity gets higher along with the gas concentration rising. MQ-3 GAs sensor high sensitivity to alcohol gas and is resistant to the interference of gasoline, smoke and vapor. It is low cost and suitable for various applications of detecting alcohol. It has wide range, long life span and simple circuit.



Figure 7: Alcohol sensor(MQ3)

#### Features

- Type: Semiconductor
- Target Gas: Alcohol Gas
- Range: 10cms ± 1-2cms

### 3.6 Raspberry PI (PI 2 B)

Raspberry Pi is a small computer which can perform multiple tasks. It has a multi-tasking OS Raspbian which is based on Linux platform. It has inbuilt Python script for python programming. Also the coding can be done in C/C++. The readymade libraries are available all over the internet. In this system the coding language used is C so the WiringPi library has been used. In this system, the Raspberry Pi takes the data from the micro controller serially. The video data from the Camera is provided to it for the live video streaming. Also the GPS co-ordinates are provided to the School Unit as well as to the Android App over the internet.





Figure 8: Raspberry pi (B plus)

#### Features:

1. Broadcom BCM2836 Arm7 Quad Core Processor powered Single Board Computer running at 900MHz
2. 1GB RAM
3. CSI camera port for connecting the Raspberry Pi camera'

## 4. Software System Design

### 4.1 Android Application

The Android Application required for this system is developed using the Android App Inventor Tool. It possesses many user friendly functions making the App easy to use.

#### What is possible with App Inventor

##### 4.1.1 Play

Creating apps for your phone is fun, and App Inventor promotes exploration and discovery. Just open App Inventor in a web browser, connect your phone, and start putting together blocks. You can immediately see and interact with the app you building on the phone.

##### 4.1.2 Prototype

There can be many ideas in real time that can be made easy through the Android App. The Inventor Tool can make the job easy by just doing the block joining instead writing the code in short can make the prototyping easy.

##### 4.1.3 Build Complete Apps

App Inventor is not just a prototyping system or an interface designer- can build complete, general-purpose apps. The language provides all the fundamental programming building blocks like loops and conditionals, but in block form.

##### 4.1.4 Teach and Learn

App Inventor is a great teaching and learning tool. It's great for computer science, but is also a terrific tool for math, physics, entrepreneurship, and just about any other discipline.

### 4.2 AVR Studio

Atmel Studio is the integrated development platform (IDP) for developing and debugging Atmel® SMART ARM®-based and Atmel AVR® microcontroller (MCU) applications. Studio 7 supports all AVR and Atmel SMART MCUs. The Atmel Studio 7 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It also connects seamlessly to Atmel debuggers and development kits.

### 4.3 Boot Loader :-Sinaprog

SinaProg is a Hex downloader application with AVR Dude and Fuse Bit Calculator. This is used to download code/program and to set fuse bits of all AVR based microcontrollers

### 4.4 PUTTY

Is a free and open-sourceterminal emulator, serial console and network file transfer application. It supports several network protocols, including SCP, SSH, Telnet, rlogin, and raw socket connection. It can also connect to a serial port.

### 4.5 VPN Client Software

A virtual private network (VPN) extends a private network across a public network, such as the Internet. It enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network. Applications running across the VPN may therefore benefit from the functionality, security, and management of the private network.

### 4.6 SoftEther VPN

SoftEther VPN is free open-source, cross-platform, multi-protocol VPN client and VPN server software, developed as part of DaiyuuNobori's master's thesis research at the University of Tsukuba .It is one of the world's most powerful and easy-to-use multi-protocol VPN software. It runs on Windows, Linux, Mac, FreeBSD and Solaris.



Figure 9: SoftEther VPN software

## 5. Results



Figure 10: LCD output (RFID)

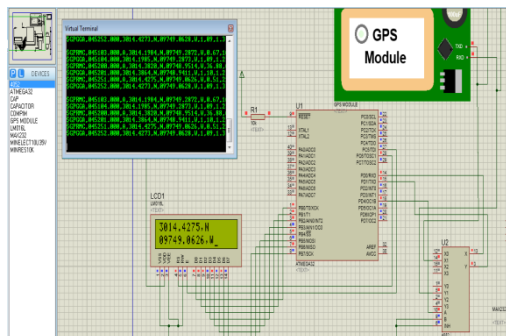


Figure 11: GPS simulation



Figure 12: Video Streaming output

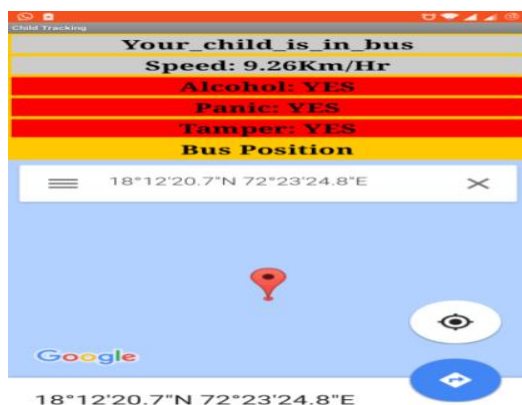


Figure 13: Android app



Figure 14: Entire project setup

## 6. Conclusion

The device implemented will provide best possible security features in limited cost. We have given portable device which provides video surveillance. This device which constantly track child at every place and provide quick information to parents and school authorities by android app. Thus this device will provide efficient solution to child security problems.

## 7. Future Scope

The system can be extended for image processing applications like face recognition for avoiding drawbacks of RFID. Static IP server can be formed for school staff for keeping simultaneous watch on large number of buses. Child monitoring database can be made at school unit. Video can be stored in memory for better security and panda board can be use in place of Raspberry pi for better image/video processing. Protection from fire can be made by adding fire alarm and ambulance alert. The GSM can also be interfaced to the system to make emergency calls..

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