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Development of a Novel Ubiquitous Client monitoring and Pervasive Vehicle Tracking System using enhanced 3G Technology for Transportation Applications

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Abstract*: *Vehicle tracking and monitoring system plays a significant role in ensuring safety and security of vehicles. These systems come handy in situations like stolen recovery vehicle, fleet management, asset tracking, fuel management, surveillance, etc. The proposed system uses Raspberry Pi as the Embedded Linux board to enhance the client monitoring and pervasive vehicle tracking system. Conventional vehicle tracking method uses microcontroller 18F45K20 and 2G technology which makes it less suitable for receiving data in tower less areas. This proposed system makes use of GPS and GSM technologies for vehicle tracking and Altium software to minimize PCB board size that could be a ubiquitous client monitoring system. GPS receiver helps in tracking the vehicle location whereas vehicle monitoring is achieved by taking pictures and videos of vehicle location with the help of Raspberry Pi camera. 3G technology is implemented to increase tracking speed and to improve monitoring. Python coding is used as the programming language in the proposed system and the novelty lies in this ubiquitous client monitoring system is recovering the complete information even after when the network restores.

Keywords*: *Altium, Client Monitoring, GPS, Raspberry Pi, camera, Vehicle tracking, 3G.

I. INTRODUCTION

Vehicle theft and fatigue driving is increasing significantly in recent years. Due to these situations, vehicle tracking and monitoring systems are in great need.

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An In-Vehicle Tracking and Monitoring system makes use of purposely designed software along with an electronic device installed in the vehicle. It enables the owner or third party to track vehicle locations by collecting data from field and sending it to website or app. Many types of automatic vehicle location technology are present but commonly GPS technology is used for tracking purpose. Using internet, vehicle information can be viewed on electronic mapsModern In-Vehicle Tracking and Monitoring systems combine both active and passive tracking abilities. When tracking device is connected and network is available, the system transmits data to server and if network is not available it stores the data in device memory and later when network becomes available it transmits them to server. This can be accomplished by installing a box inside the vehicle with the system being either self powered with battery or powered from the vehicle's power system. They can be used to track different activities within the vehicle such as GPS position, fuel indicator, speed, seatbelt details, etc.

II. LITERATURE SURVEY

Zarith Liyana Zahari, et al [1] has proposed an Implementation of Raspberry Pi on Children tracker Application whose idea is to enhance children safety protection. The Proposed system consists of Global Positioning System (GPS) module interfaced with Raspberry Pi, android application with web server. GPS module helps in detecting child's location and sends it to raspberry pi which acts the main controller. The obtained latitude and longitude are then sent to server from raspberry pi. The client can view child's location on website. This system allows the client to keep track of the child anytime and in any weather conditions. These systems are user friendly, of low cost and installation is also easy.

Prashant A. Shinde, et al [2] has proposed an advanced system towards monitoring and tracking of vehicle which uses Raspberry Pi as the Embedded Linux Board for enhancing the technology. GPS/GPRS/GSM SIM900A Module is being used which helps to locate and determine the position through webpage when it is placed inside the vehicle. With the help of android application, a specified path in raspberry pi's file system is obtained and compared with the current path of the vehicle. The proposed system improves the safety and security of the vehicle by sending alert messages to the vehicle owner's mobile phone indicating the change in vehicle's direction.

Likewise the same happens when speed increases beyond specified value. Gas leakage sensor and temperature sensor are used to ensure the safety of traveller. Video Surveillance systems are used widely in public and private environments for increasing security purpose. In the paper Live Video Streaming System Using Raspberry pi with Cloud server Deepa.A, et al [3] has designed system in which embedded chip and programming techniques are used.

Raspberry Pi is chosen as the embedded Linux system which forms the core of the project. Video data from USB camera are collected by Raspberry Pi and stored in its memory. Processing Chip compresses the stored data and transfers it to mobile client through wireless network. The traditional video surveillance systems are poor stability, high cost and complicated structure.

The proposed system can be used to eliminate the disadvantage of traditional system. MJPG streamer which is loaded into Raspberry Pi is cross compiled and used for streaming the captured video. This system offers better performance as long distance transmission can be achieved.

Luigi Atzori, et al [4] has done a survey towards the Internet of Things that addresses the integration of various technologies and communication solutions. This paper helps those who want to study complicated scenario and contribute for its development. Internet has moved the interaction to virtual level between people in both public and private life.

Internet of Things is considered to play a major role in internet's future. Data-centric networks are addressed in which data and related queries are self-routable and self-addressable [5]. IoT refers to integration of several wireless devices, microdevices and internet.

Frequent occurrences of vehicle theft are increasing the concern of every citizen to increase the safety of their vehicle [6-8]. Zhigang Liu, et al have developed a vehicle anti-theft tracking system which makes use of Internet of Things (IoT) to enable an all-round active service for the owners. The system gets switched on and off using RFID. Inside which, the vehicle sensors are mounted and they get triggered when the car gets stolen. Simultaneously the owner will be informed about the vehicle's location by sending that information to owner's mobile from GSM module. The owner can then use android applications to view the vehicle's location on map. The sensors used for this system are pyroelectric infrared and vibration sensors.

III. SYSTEM ARCHITECTURE

System architecture of the proposed system is depicted below in the form of a block diagram which is shown in Figure 3.1.

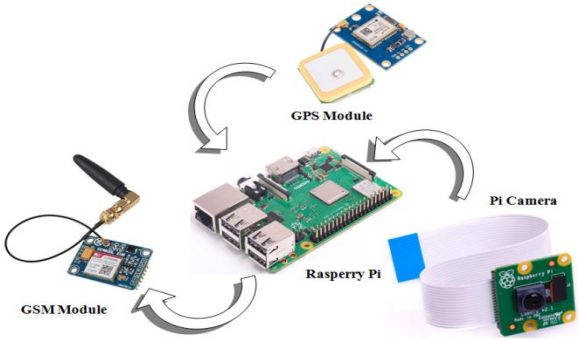

Figure 3.1 Proposed System Architecture

In this system, vehicle tracking and monitoring using raspberry pi is implemented. This proposed system consists of Global Positioning System (GPS) module, GSM/GPRS module, Raspberry pi kit, Power supply unit, Raspberry pi camera. GPS module gets the latitude and longitude details of the vehicle from satellite which then gets stored in raspberry pi. The stored details are then sent to server with the help of GSM/GPRS module from where the vehicle data gets uploaded to website.

The client or user can then view the vehicle location on electronic map in the website. Raspberry Pi camera is used to take photos and videos of the vehicle path. In this system, vehicle tracking is achieved by GPS module and vehicle monitoring is done by Raspberry pi camera. The photos and videos obtained by pi camera are then sent to client or user through email for security purpose.

A. Raspberry Pi

The proposed system having Raspberry Pi constitutes the hub of this system. It is a miniature computer which is just looks like a small sized credit card and it is initially developed for teaching basic computer science in schools. It consists of a ARM compatible Central Processing Unit integrated with Broadcom System On a chip (SoC), Secure Digital (SD) card, Graphics Processing Unit (GPU), USB slot, HDMI out, Ethernet port having General Purpose Input-Output (GPIO) pins, CSI, USB power slot, etc. Raspbian is used as the operating system for this project which is burned into the SD card mounted into Pi. Commercially available Raspberry Pi models which include raspberry pi 1 A, A+, B+, Raspberry Pi 2, Raspberry Pi 3, Raspberry Pi Zero, etc. Users can select any type of Raspberry Pi depending upon their needs. Raspberry Pi needs 5V/2A power supply to turn ON.

B. Global Positioning System

GPS receivers passively get signal from GPS satellite but they do not transmit to them. It receives an unobstructed view of the sky to properly receive signals from satellites. In other words it will not get FIX when there is no view of the sky. L80 GPS receiver is used in this project to get the latitude and longitude data of the vehicle from satellite.

It has an GPS POT (Patch On Top) pack of slim in size which contains an integrated patch antenna of 15.0mm x 15.0mm x 4.0mm. This model is well suited for acquisition and tracking and best for developing miniature devices. NMEA 0183 standard messages are supported in L80 module. The data obtained from the satellite are stored in raspberry pi from where it can be uploaded to the server.

C. System 3G Modem

3G technology is adopted for uploading the data stored in raspberry pi to the server. Transmission is achieved by TCP/IP communication. GPRS architecture works well with the protocols of GSM. It is compact in size and connected via the USB port available in Raspberry Pi. It plays a major role in providing the required information to the client by making the information available through website or mobile app

D. Raspberry Pi Camera

Raspberry Pi camera needs 250mA power supply and works well with all models of Pi. Its library relies on libmmal which is specific to Pi's camera module. It has 15 cm ribbon cable attached to it and utilizes dedicated CSI interface which is capable of high data rate transmission. It supports 2592x1944 pixel static images, 1080p30, 720p60 and 640x480 p60/90 video resolutions.

IV. RESULTS AND DISCUSSION

The main aim of this project is to do track and monitor of the vehicle. The project can be divided into three steps which consist of vehicle tracking, vehicle monitoring and surveillance.

Vehicle Tracking is accomplished by connecting L80 GPS receiver module serially through GPIO pins in Raspberry. GPIO pins in raspberry pi can be seen below in Figure 4.1.

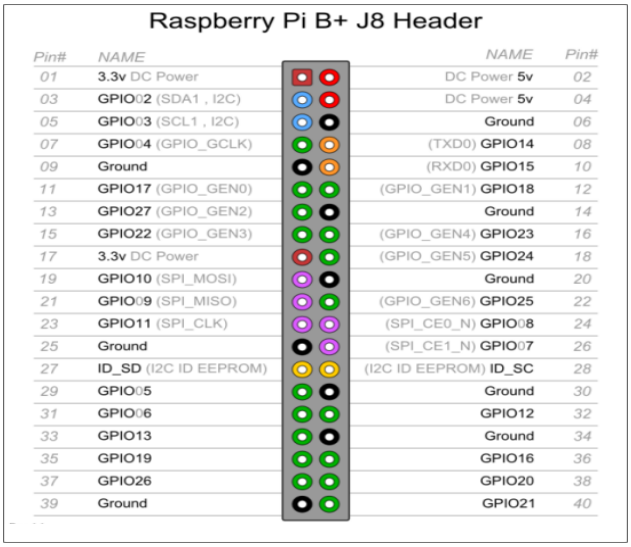

Figure 4.1 GPIO Pin configuration in Raspberry Pi B+

GPS receiver requires 3.3v supply and it is connected to pin 6 and 10 of Raspberry Pi. Python code is used as the programming language. Data from GPS receiver are sent to server to get updated in the website. By doing so, the client can view the vehicle information or location from anywhere. Client side application to view vehicle detail is shown in Figure 4.2.

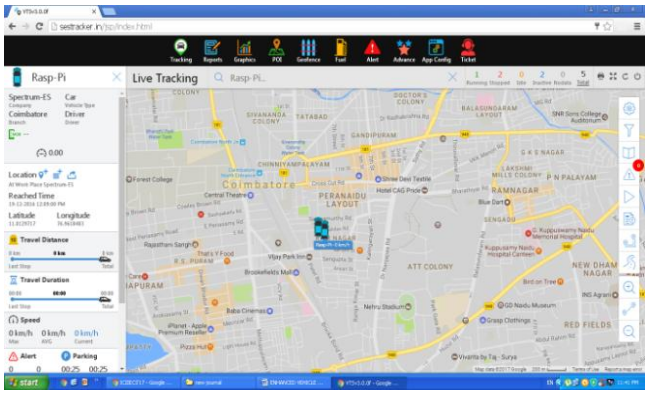

Figure 4.2 Client side application

Likewise Vehicle Monitoring is done with the help of Raspberry Pi camera. It is interfaced to Raspberry Pi's CSI port with flex cable.

First the Pi camera should be set up with Pi before capture. When the vehicle starts to move it captures photos and videos which gets stored in Raspberry Pi. With the help of python code, the stored photos and videos are sent to the server.

Figure 4.3 shows the image of Picamera and GPS receiver connected with Pi.

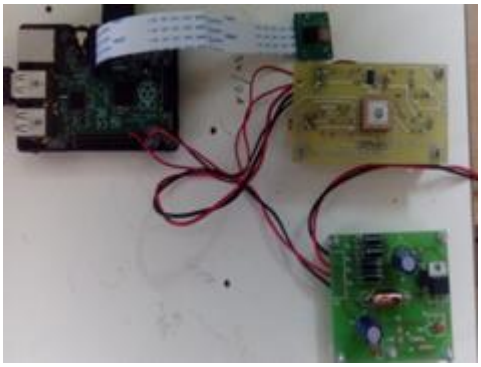

Figure 4.3 Pi with GPS Receiver and Picamera

Security purpose is further enhanced by sending the captured photos and videos to the client's Email. This is carried out by specifying the sender and client Email address in the python code. In addition to this a twitter app is created to which the captured images are tweeted. If more than one person needs to view the vehicle detail the above method can be adopted. Images and videos received by client via Email is shown in Figure 4.4.

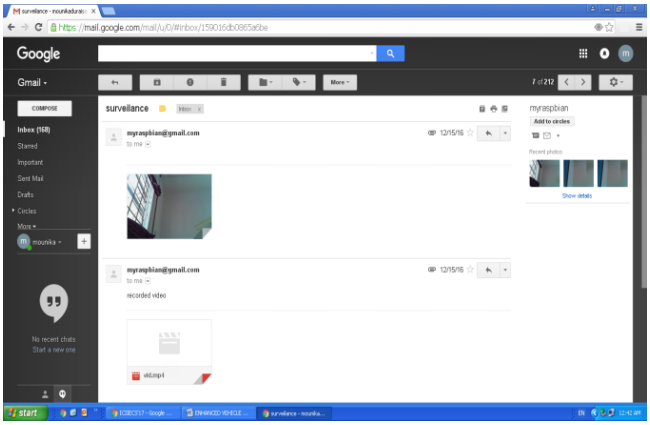

Figure 4.4 Images and videos receiver through Email by client

V. CONCLUSION

The proposed system helps in achieving upgradation in vehicle tracking and monitoring system technology. Python is used for transferring data between raspberry pi and website since its simple to use. Raspberry Pi is used to enhance tracking and monitoring purpose.The major benefit of this proposed ubiquitous client monitoring system is that it works in any environmental condition and easy to install inside the vehicle because of their compact size.

It stores vehicle detail in tower less areas and sends them to server when network connection occurs. So loss of data can be avoided. This novelty of retrieving the information could be beneficial for the ease of pervasive vehicle tracking. Thereby, security is enhanced by capturing photos and videos and making it available for client to see in twitter or in the client mail.

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