Modern Architecture Tracking System Using Modern GPS Module

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Abstract— This paper concerns the practical design and implementation of professional tool using GPS in tracking and fleet management, the GPS is the premier satellite navigation system in the world. Not only is it used for military navigation but also it has become a major commercial and benefit as new applications have been found and low- cost GPS radios have become available, required for operation of all installed navigation equipments, aircrafts, ships, cars, trains, and most of tracking systems, etc. . A small system containing GPS receiver is installed in each vehicle of the fleet supported by GPRS communication module. This unit will allow the fleet manager to control all the vehicles' movements: present, previous positions, start of the journey, and non movement periods. Using the proposed designed system we can track all the ships, cars, trains, vehicles all time, with GPS positions and sensor data being received every minute. Optional add-ons include cost management, integrated navigation module for drivers, two-way text communication, fuel control and automatic driver identification. Data collected from the vehicles is processed, to get reports. Those reports can be sent automatically to the assigned position mailboxes by email in right time. Difficult situations are also immediately detected and reported by email and SMS as an alarm. All you need to access system is an internet connection and a web browser at anywhere. In our design, GPS Module was utilized with the SkyNav SKM53 Series has embedded GPS antenna enable high performance navigation in the most stringent application and solid fix even in harsh GPS visibility environment, and microcontroller 16F877. For programming of the microcontroller, software PIC Basic pro was used, a window based Software. The complete designed system has basic and optional features as we operate in real time GPS tracking solution, GPS positioning, and use GPRS communication which is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM), vehicle status report, two way communication, automatic reports and alarms. Other optional features are SMS massages for mobile phone, cost management, anti –theft vehicle protection, and can be integrated for fuel status. More over the designed system will be demonstrated as anti crash or anti collision system.

Index Terms— GPS, Tracking system, Safety and protection, microcontroller, GPRS, Signal Processing, Sensors

1 Introduction

THIS paper is a practical design of a modern architecture tracking System using modern GPS. System can be used in any types of vehicles, not only for tracking but also for cost management, integrated navigation module for drivers, two-way text communication, fuel control and automatic driver identification. In our design, we make use of advances in technology that have led to the solid state electronic GPS Module was embedded GPS antenna. The Integrated system Navigation provides not only interaction of the data centre with the drivers, through text, but also the possibility of navigation to destinations received from the data centre [1, 2]. Destinations places can be sent directly from the data centre to a driver's navigator, along with written instructions. The driver will just follow the instruction on the screen to navigate to the destination. Text messages can also be sent and received efficient and cheaper alternative to phone calls, especially in the case of international transports. Text messages are immediately displayed on the display. The driver will be able to reply. All messages sent and received are kept for future reference. The system requires internet service.

2 Requirement for the complete system

In each vehicle we have the first part of the hall system it consists of GPS module to give the LAT and LONG, to microcontroller PCB board, the output from the car as CAN or from the train as RS-48S format which is fed to the microcontroller PCB board, he microcontroller board is connected to the LCD display, On the board the microcontroller has its all require element for operation. The output of the microcontroller is attached to open architecture modem to deal with GPRS for transmition; the data is transmitted by GPRS. On the other side we have the second part of the system consists of the reception modem fed the control unit; this unit have display that can display the data for all the vehicles, the control centre can transfer data to net, send orders, and receive SOS and alarm massages. The control centre is connected to the site.

3 System General Description

Antenna is miniaturized ceramic GPS patch antenna based on smart XtremeGain technology , it is mounted via pin and double sided adhesive and has been tuned as optimal solution for the the rang [Hz, Imp po- lariz

Fig.1 Antenna for GPS [2]

The SkyNav SKM53 Series as shown in fig. 2 with embedded GPS antenna as shown on fig. 1 enables high performance navigation in the most stringent applications and solid fix even in harsh GPS visibility environments. It is based on the high performance features of single-chip architecture, its –165dBm tracking sensitivity extends positioning coverage environment where the GPS was not possible before. The UART and USB connector design is the easiest and convenient solution to communication with other electronic equipment.

Features are Ultra high sensitivity: -165dBm, 22 tracking/66 acquisition-channel receiver, WAAS/EGNOS/MSAS/GAGAN support, NMEA protocols (default speed: 9600bps), Internal back-up battery, One serial port. Embedded patch antenna 25 x 25 x 4.0 mm, Operating temperature range: -40 to 85℃, Tiny form factor : 46 * 45 * 15mm. [2]

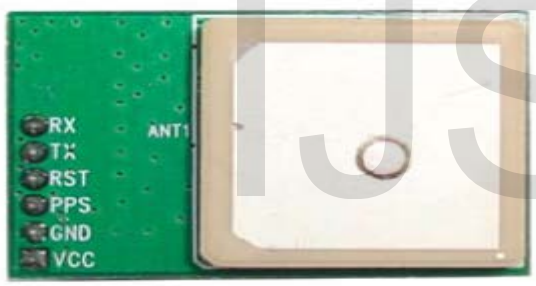

Fig.2 GPS Module Top View [2]

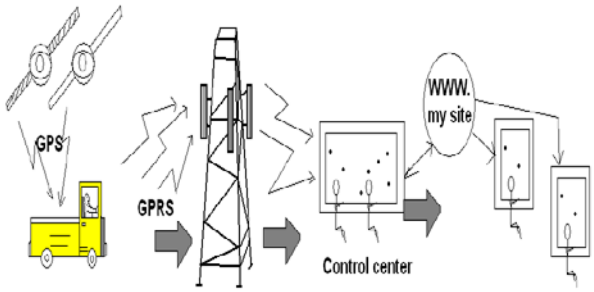

Fig.4 the Total System Connection

4 THE CIRCUIT DIAGRAM

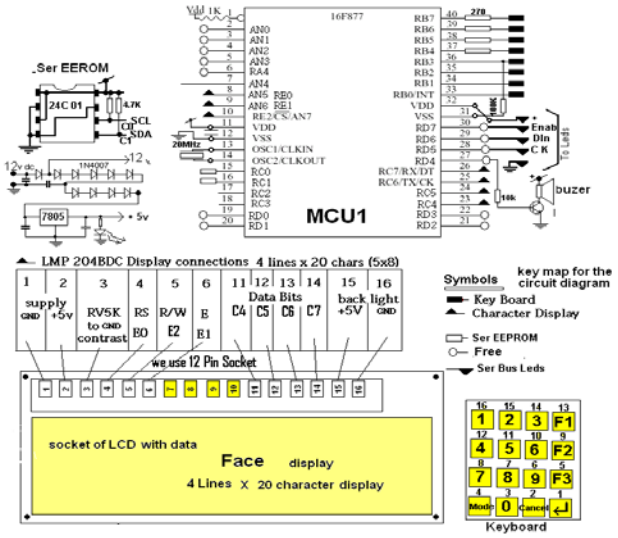

Fig.5 The System connection diagram for the first part

The designed system is shown in Fig. 4 as a complete system, it is mainly consists of 2 subsystem; the 1st one is the electronic unit in the vehicle, train as shown Fig.5, fig 8 represent the real design this first subsystem contains 4 subunits, the 12 voltage transformer with a rectifier or 12 volt battery, key board, liquid crystal display, PCB contain both the microcontroller and GPS module. Fig 6 shows the circuit connection of the GPS module with microcontroller on PCB, fig. 7 show the real designed PCB. Fig.9 Pin assignment circuit diagram for the subunits Lay out and connection of GPS, key board and microcontroller.

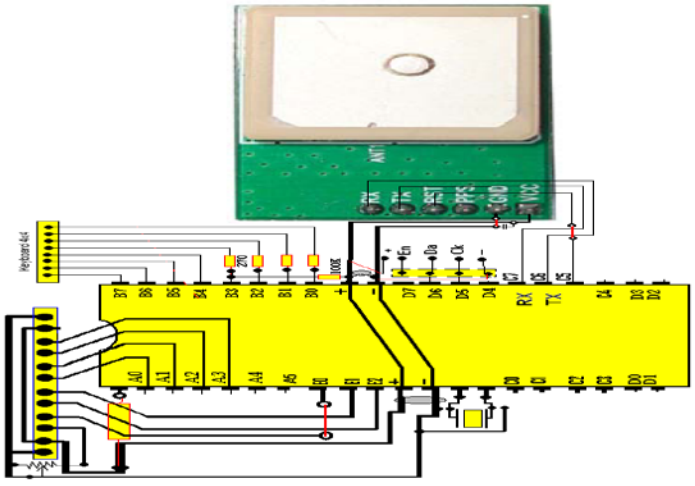

Fig.6 Lay Out and Connection of GPS and Microcontroller

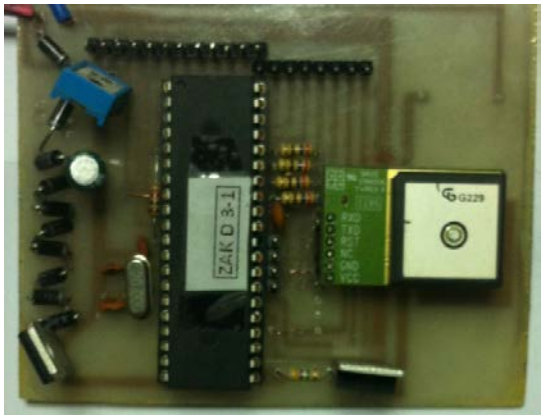

Fig.7 Real Connection of GPS Module and Microcontroller

Fig.8 Real Connection for the Subunits for the System First Part

GPS module and microcontroller in the same board, display, and key board

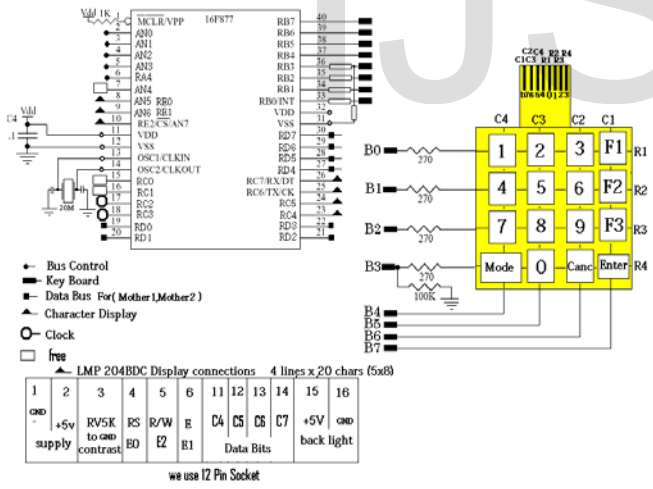

Fig.9 Pin Assignment Circuit Diagram for the Subunits

5. Lay out and connection of GPS, key board and microcontroller

The second subsystem is located in the control centre on the other side in which we have the reception modem that fed the control unit or data centre; in data centre we have large display that can display the data for all the vehicles, the data centre can transfer data to net, send orders, and receive SOS and alarm massages. The control centre is connected to the website. Between both subsystems we have the communication which we recommend to use the GPRS technology.

6. GPRS Technology

General packet radio service (GPRS) technology evolution are from 1990 to 2000 we go through GSM, GPR then EDGE, from 2000 to 2010 we go through UMTS, HSPA, then LTE, FROM 2011 to 2914 we come to LTE-Advanced. GPRS is one popular 2.5G technology; this system is designed to work with GSM phones. It uses one or more of the eight TDMA tome slots in a GSM phone system to transmit data rather than digitized voice. Depending on how many of the eight time slots are used, the data rate can vary from about 20 Kbps up to a maximum of 160 kbps. A typical rate is about 40 kbps, which is more than enough for e-mail and short message service (SMS) but poor for internet access. Each GSM frame has eight time slot for data as shown in fig 10. The overall bit rate is 270 kbps. As in voice operation, each slot contains the compressed or vocoded voice signal. In GPRS, other types of data can be transmitted. The data rate that can be achieved is a function of the type of coding used (ETSI), is now maintained by the 3rd Generation partnership project (3GPP). It defines four levels of data coding referred to a CS-1 through CS-4. The most robust coding scheme CS-1 produces fewer errors, but the maximum data speed per slot is 8 Kbps. The least robust coding method is CS-4, but it produces a data rate to 20 kbps. To achieve maximum data rate, you could use all eight slots for a rate of 8 * 20 kbps = 160 kbps. However, this is never done. Instead, GPRS defines 12 classes that give different levels of data speed. The selection of the desired class is made by the cell phone carrier who sets just how much of the network capacity is devoted to voice and to data. [1]

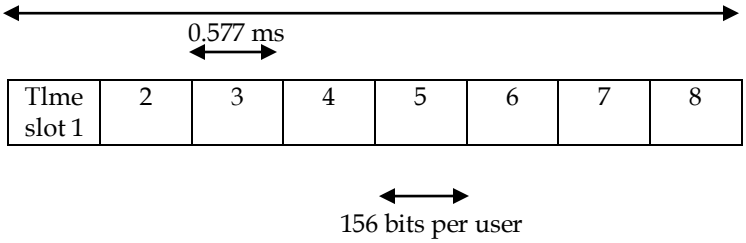

Fig. 10 GSM TDMA Frame for Eight Time Slots [1]

7. Services offered and Protocols supported by GPRS

GPRS extends the GSM Packet circuit switched data capabilities and makes the following services possible: SMS messaging and broadcasting, "Always on" internet access, Multimedia messaging service (MMS),Push to talk over cellular (PoC), Instant messaging and presence wireless village, Internet applications for smart devices through wireless application protocol (WAP), Point-to-point (P2P) service: inter-networking with the Internet (IP), Point-to-Multipoint (P2M) service, point-to-multipoint multicast and point-to-multipoint group

calls [3, 4]If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than using the ordinary SMS over GSM, whose SMS transmission speed is about 6 to 10 SMS messages per minute. GPRS supports the following protocols: Internet protocol (IP), Point-to-point protocol (PPP), X.25 connections. When TCP/IP is used, each phone can have one or more IP addresses allocated. GPRS will store and forward the IP packets to the phone even during handover. The TCP handles any packet loss (e.g. due to a radio noise induced pause), example of 3G/GPRS Modem is Huawel E220 [5, 6, 7]

8. SOFTWARE USED IN THE DESIGN

USASCII code chart

Bits	b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 b_3 b_2 b_1	Row ↓ Column →	0	1	2	3	4	5	6	7
0 0 0 0	0	NUL	DLE	SP	0	@	P	`	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	{
1 1 0 0	12	FF	FS	,	<	L	\	l	|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	_	o	DEL

Fig.11 USASCII code chart

Our designed SW is written in Pic Basic Pro to 16F84a microcontroller. For Programming we need USASCII as shown in fig 11, programs are available under request.

9. THE COMPLETE SYSTEM DESIGN

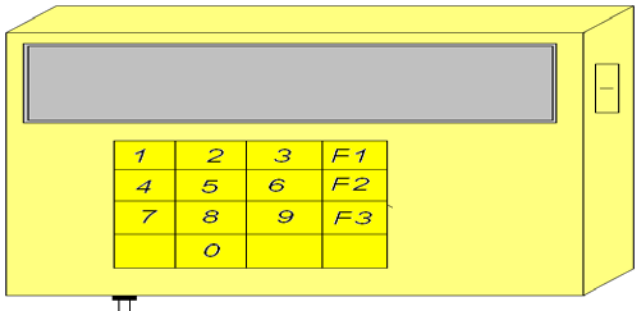

Fig. 12 represents the complete designed electronic hand held unit

Fig. 13 represents one of the real installations of the keyboard and display

10. CONCLUSION

In this design, a Computerized Modern architecture tracking System using modern GPS was developed as a technology to improve tracking of ships, cars, trains, and different types of cargo, communication between the vehicle and control center use GPRS technology. By applying this system we have Modern architecture tracking System using modern GPS , able to prevent unauthorized use of vehicles, provide drivers' observation, help to avoid traffic jams, Navigation will help drivers to get to destination faster ,Fast and reliable information to dispatchers, increase the efficiency of the fleet. It will economize fuel consumption, the location and status of each vehicle is known, it will improve security of vehicle against non allowable use, and facilitate supervision process [8]. Moreover; it can send SOS massage at certain condition. System provide high quality, cost effective solution backed by open architecture design and can be used for a wide variety of application. The system proved high level of security, cheap and can be used to more complex designs according to requirements. It can be used in wide scale in commercial as tracking and alarm system for any application. Designed system can be used as vehicles anti collisions system, in this case the location of each vehicle is determined with high accuracy using GPS, and using the mobile with GPRS and the data is transmitted by GPRS technology to send the position, and speed tagged with time to the data centre then deploy the position on electronic chart, , by receiving all vehicles data on the main server we can calculate the requirement for anti collisions using automated plotting aids (ARBA) for closest point of approach, time for closest point of approach, and guard zone etc. we use the satellite in case of no mobile cover, also the sent data can be encrypted for more security. As result of ARPA calculation the action will be taken staring from warning massages, send order to reduce the speed till stop the vehicle completely with taking the precautions on this action. More over the system can be used for management using the engine and driver status. [9]

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