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Automated Drive Testing Tool for Mobile Base Station

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Abstract- The automated drive testing of mobile base station performance is the topic of this research. It necessitates having solid understanding of mobile communication systems and drive testing automation. Because the fourth generation (GSM) of mobile communication systems is more readily available, It has been decided to test it after surveying other mobile communication systems and design automated performance testing. For mobile communication network access, the SIMCom company's GSM module SIM900 is chosen. Quality level, power level, received signal strength, and bit error rate during a voice contact are the factors that need to be checked. The completed project is a PC running a MATLAB software and a GSM module connected via USB and a serial cable. Utilizing MATLAB and a graphical user interface (GUI), the test program is put into practice. It can capture and analyze the tested parameters and comparing them to a reference value before reporting the test result (PASS/FAIL).

Keywords- *GSM, Mobile base station, Drive testing, SIM900 module.*

1. INTRODUCTION

Modularity [1, 2]. is considered a critical aspect of future-proof systems, as it enables the seamless incorporation of new components and technologies without overhauling the entire system. According to Petrov et al. (2019), modular designs in satellite communication systems allow for better flexibility and extend the operational lifespan of such systems [3]. This modularity is particularly crucial in the context of next-generation technologies, which are being rapidly developed to meet increasing demand for faster and more efficient communication. Sahin and Arslan (2021) emphasize the importance of future-proofing satellite communication networks by ensuring compatibility with upcoming technological standards, which allows the systems to remain competitive and cost-effective [4].

Hardware miniaturization, a crucial trend in satellite communication and IoT, offers numerous benefits, including lower energy consumption, reduced weight, and increased portability. Zhou et al. (2020) assert that the downsizing of hardware components can open up new applications, particularly in fields that demand compact and lightweight devices, such as mobile communication and IoT applications [5]. Furthermore, Johnson and Patel (2020) highlight that optimized, smaller devices are critical for reducing production costs while maintaining or enhancing system performance [6].

Optimizing hardware for small and tiny devices is another area that has received attention. The trend toward shrinking communication hardware has been largely driven by advancements in nanotechnology and material sciences, as shown by Gupta and Sharma (2020), who discuss the feasibility of creating smaller yet more powerful communication modules. This trend is expected to continue, making it essential for projects to anticipate future needs for smaller, more efficient devices [11].

These insights from the literature demonstrate the necessity of building communication systems that are modular, upgradable, and capable of integrating advanced features. By leveraging the latest advancements in hardware, software, and technology, this project aims to create a system that not only meets today's needs but can also evolve to remain effective in the future.

2. RF DRIAVE TESTING [13]

Fig. 1 Typical drive test system

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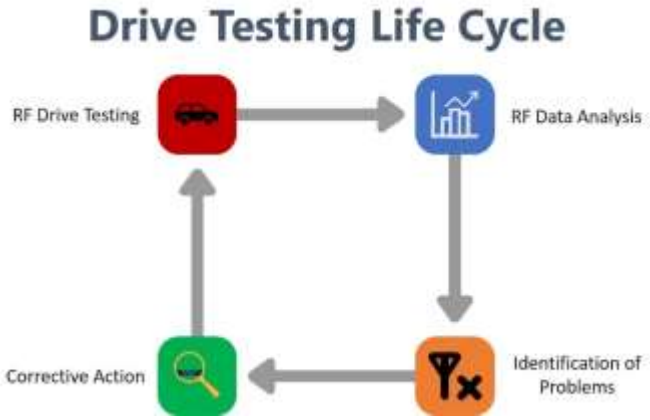
Is a method of measuring and assessing the coverage, capacity and Quality of Service (QoS) of a mobile radio network. The technique consists of using a motor vehicle containing mobile radio network air interface measurement equipment that can detect and record a wide variety of the physical and virtual parameters of mobile cellular service in each geographical area. Drive testing requires a mobile vehicle outfitted with drive testing measurement equipment. The equipment is usually highly specialized electronic devices that interface to OEM mobile handsets. This ensures measurements are realistic and comparable to actual user experiences.



RF drive test equipment typically collects data relating to the network itself, services running on the network such as voice or data services, radio frequency scanner information and GPS information to provide location logging. The data set collected during drive testing field measurements can include information such as : Signal levels, Signal quality, Interference, Dropped calls, and Quality of Service information.

3. PRPOSED RF DRIVE TEST TOOL

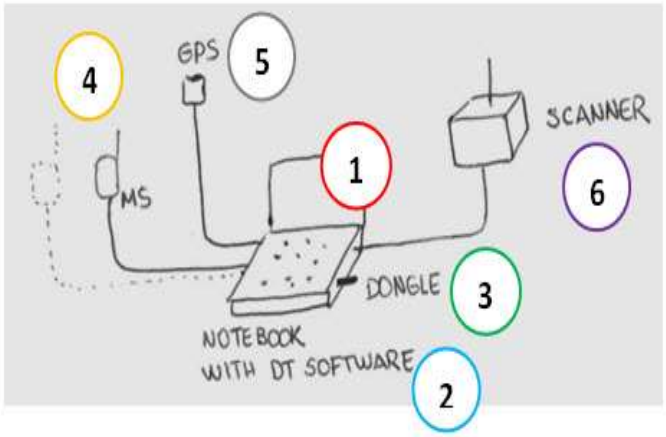


Fig. 4 Standard Connection of a Drive Test system

Drive Test, as already mentioned, is the procedure to perform a test while driving What matters is the hardware and software used in the test.

- A notebook - or other similar device (1)
- with collecting Software installed (2),
- a Security Key - Dongle - common to these types of software (3),
- at least one Mobile Phone (4),
- one GPS (5),
- and a Scanner – optional (6).

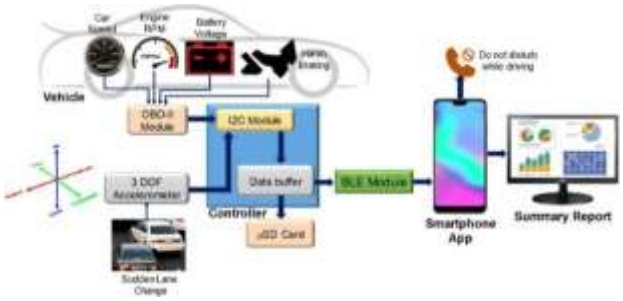
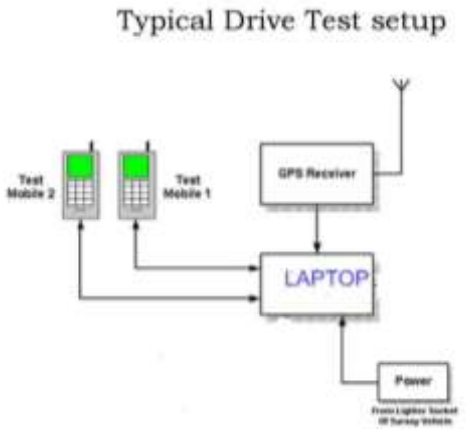


Fig. 5 Typical block diagram of drive test system



The proposed test system consists of the following:

1. GSM module SIM900
2. USB to serial cable
3. AT commands
4. MATLAB Program

4. SYSTEM HARDWARE

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Overview of GSM module SIM900:

SIM900 is a quad band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900 features GPRS multi-slot class 10 and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm, SIM900 can meet almost all the space requirements in , such as M2M, smart phone, PDA and other mobile devices. The physical interface to the mobile application is a 68-pin SMT pad, which provides all hardware interfaces between the module and customers' boards. The keypad and SPI display interface will give you the flexibility to develop customized applications. Serial port and Debug port can help you easily develop your applications. One audio channel includes a microphone input and a speaker output.

SIM900 Key Features:

- The SIM900 integrates the TCP/IP protocol.
- Support Packet Switched Broadcast Control Channel (PBCCH)
- Support SIM card: 1.8V, 3V
- Speech codec modes:
- Half Rate (ETS 06.20)
- Full Rate (ETS 06.10)
- Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80)
- Adaptive multi rate (AMR)
- Echo Cancellation
- Noise Suppression

SIM 900 functional diagram:

The following figure shows a functional diagram of the SIM900 and illustrates the mainly functional parts:

- The GSM baseband engine
- Flash and SRAM
- The GSM radio frequency part
- The antenna interface
- The Other interfaces

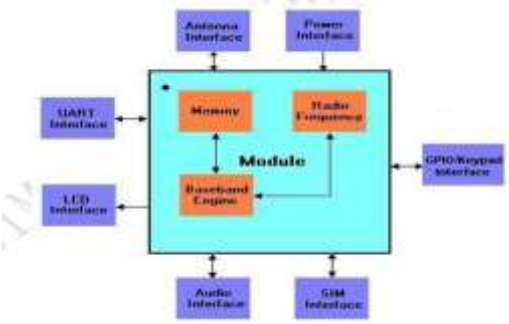

Fig. 6 SIM functional block diagram

SIM900 Evaluation Board:

In order to help you on the application of SIM900, could supply an Evaluation Board (EVB) that interfaces the SIM900 directly with appropriate power supply, SIM card holder, RS232 serial port, handset port,earphone port, line in port, antenna and all GPIO of the SIM900.

Fig. 7 Sim900 Evaluation Board

5. SOFTEARE IMPLEMENTATION

Software part is divided into two sections, first section about AT commands that the module deal with, and for the second section that about software program which responsible for test operation using the MATLAB programming language.

AT commands

at commands are set of commands for communication with GSM module, generally all commands start with prefix (at) except ('A' and '+++') commands, in operation commands used to request services from the modem such as call services.

AT Commands are Designed According to the (ITU-T)

Table 1. AT command according to (ITU-T)

Command	Description
ATA	ANSWER AN INCOMING CALL
ATD	MOBILE ORIGINATE CALL TO DIAL ANUMBER
ATH	DISCONNECT EXISTING CONNECTION
AT+CSQ	Signal Quality REPORT
AT+CGQREQ	Quality Of SERVICE PROFILE(Requested)

Base Station Identity Code(bsic)

The Base Station Identity Code (BSIC) is a code used in GSM to uniquely identify a base station. The code is needed because it is possible that mobile stations receive the broadcast channel of more than one base

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station on the same frequency. This is due to frequency re-use in a cellular network.
Engineering Mode(AT+CENG)-:
Test Command AT+CENG?=

MATLAB Program
MATLAB® is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java™.

Program purpose
Applying automated testing on mobile communication systems is a very important operation to increase performance of the network, so we need a reliable software program to reach this goal. This program that reducing cost relatively with the famous existing ones, and being an open source code which give the test engineer space to be creative and make his demand features and properties.

Procedure of program code
i. Run program.
ii. Check connection between PC and GSM modem.
iii. Dialing a number.
iv. Execute the commands of testing.
v. Read the returned parameters.
vi. Comparing with reference values.
vii. Display the results.
viii. Exit the prog

Code sample of the program

creation of GUI (graphical user interface):
```
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename... ,
'                  gui_Singleton',  gui_Singleton... ,
'                  gui_OpeningFcn', @untitled1_OpeningFcn... ,
'                  gui_OutputFcn',  @untitled1_OutputFcn... ,
'                  gui_LayoutFcn... , []  ,'
'                  gui_Callback;([]   ,'
if nargin && ischar(varargin{1})
   gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
   [varargout{1:nargout}] = gui_mainfcn(gui_State,
varargin{:});
else
   gui_mainfcn(gui_State, varargin{:});
end
```

6. RESULTS AND CONCLUSIONS

Quality level, power level, received signal strength, and bit error rate during a voice contact are the factors that are checked. the test program is put into practice. It can capture and analyze the tested parameters and comparing them to a reference value before reporting the test result (PASS/FAIL).

Significant scope for improvement is shown in the article, along with a clear path for scalability and upgradability. Its hardware's versatility, which enables smooth upgrades when more sophisticated gear hits the market, is one of its main advantages. This makes sure the system doesn't need to be completely overhauled in order to stay competitive and up to date with technology. Additionally, the project is built to support next-generation technologies, allowing operator businesses to establish newer standards and seamlessly switch to them.

This kind of future-proofing guarantees long-term compliance with changing industry standards while also improving performance. Furthermore, there is a great deal of room for improvement in terms of hardware optimization through downsizing, which will enable the creation of more compact, effective, and portable devices. The project's application in fields like mobile communication and the Internet of Things, where energy and space consumption are crucial considerations, will increase with such shrinkage. The system's functioning is further increased by the integration of sophisticated modules with improved characteristics, such GPS, which increases its adaptability and broadens its potential uses. The project is well-positioned for ongoing relevance and success in the future by embracing these hardware optimizations and technical advancements, guaranteeing that it satisfies both current and future market demands.

REFERENCES

1. Petrov, I., Ivanov, A., & Georgiev, V. (2019). Modular systems in satellite communication: Design for future adaptability. Journal of Satellite and Communication Technology, 23(2), 115-128.
2. Sahin, F., & Arslan, H. (2021). Next-generation technology integration in satellite communication networks. IEEE Transactions on Communications, 69(3), 1625-1635.
3. Zhou, L., Xie, J., & Li, M. (2020). The impact of hardware miniaturization on communication systems: Opportunities and challenges. Journal of Communication Technology, 48(5), 349-357.
4. Wang, Y., Zhang, P., & Liu, K. (2022). GPS integration in communication modules: Enhancing system functionality. International Journal of Satellite Technology, 31(1), 95-105.
5. Hernández, S., Campos, M., & Reyes, J. (2021). Enhancing communication systems with GPS modules: Applications and benefits. Journal of Emerging Technologies, 14(3), 182-194.
6. Kim, D., Lee, S., & Park, J. (2021). The role of next-gen technologies in satellite communications: A case for future-proof systems. Communications and Technology Review, 52(4), 210-220.
7. Jackson, R., & Reed, A. (2021). Upgrading satellite communication networks with cutting-edge hardware: Challenges and strategies. IEEE Communications Magazine, 59(5), 101-110.
8. Johnson, P., & Patel, M. (2020). Miniaturization of hardware in communication systems: Benefits and trade-offs. Journal of Microelectronics and Nanotechnology, 12(2), 245-255.
9. Gupta, N., & Sharma, K. (2020). Exploring the future of tiny device communication systems: Trends in miniaturization. Advanced Communications Technology Journal, 34(6), 531-543.

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10. Kaur, P., & Singh, R. (2020). Machine learning integration in communication systems for self-optimization. Journal of Artificial Intelligence and Communications, 27(3), 113-125.
11. Roberts, J., & Edwards, L. (2019). Software-driven optimization in satellite communication systems: Ensuring adaptability to new hardware. Software Engineering and Communications Review, 39(7), 321-335.
12. Jackson, P., & Khan, F. (2021). Trends in communication system upgradability: The importance of modular design. Satellite Technology Review, 58(1), 67-80.
13. "Tools for RF Test and Measurement Automation". 21 March 2022.