Architecture of Automated System Software for Testing Petrol Engines

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Abstract – **The paper presents an approach to developing systems for automation of laboratory investigations, already implemented at the University of Ruse. The automated microcomputer system is for testing of internal combustion engines by means of an eddy current dynamometer generates various family curves of engines under test.**

Keywords – **Laboratory experiments; Scientific experiments; Automated systems; Software.**

I. INTRODUCTION

When solving a number of highly complicated technical problems in the field of internal combustion engine testing, the immediate participation of a man in the performance of some experiments is not possible. In these cases the real experiments can be replaced by laboratory ones on the basis of Automated Systems for Scientific Investigations (ASSI).

This paper focuses on Automated Systems for Scientific Investigations software that has been developed in University of Ruse for Testing of petrol Engines. The system was developed noting the advantages and disadvantages of similar systems [1-5].

II. FUNCTIONS AND OPERATION MODELS OF ASSI

ASSI for testing of petrol engines operates in the following modes:

- Adjustment: - Technological process and control system configuration. The configured data base that includes some elements of the relation data bases such and data searching is updated, if necessary. With the help of the data base, the parameters of the technological processes simulations, the tasks, the translations, the control system adjustments, etc. are configured;
- Measurement: - Registration of the main parameters of the tested object. The operator has the possibility to examine the most important information concerning the process conditions, in particular - inlet/outlet points whose values exceed the pre-set-limits;
- Control: - The system's automatic control is implemented on the basis of the information coming from the object and the tasks set by the operator. The face panels of industrial regulators and the programmable controllers which have been developed, simulate the actual units. They enable the operator to observe and control all tasks and system adjustments in real time mode. The digital inputs and outputs as well as states of the alarms are displayed as Boolean indicators;
- Simulation of the running processes in real time mode: - It provides a possibility for investigating the influence of different signals (i e., change of colours text messages, audible alarms, etc.) over the operator on emergency;
- Testing: - This mode serves for performing different verifications of the correct functioning of any unit and the system as a whole on adjusting, for controlling in the process of preventive maintenance, for searching the reasons that caused error conditions during control program running, and also for adjusting the parameters of the hardware components.

ASSI implements the following functions:

- Acquisition and initial processing of analogue and digital data of the engine's main parameters;
- Automatic stabilization of the control contours of the supply, the advance angle of ignition and loading;
- Carrying out of any control algorithm given as a program;
- Automatic registration of object's states;
- Signaling and registration of extreme and emergency states;
- Start/stop control of the tested object;
- Interaction allowing the intervention in the control and the display of operative information (task, current regulated quantity, extreme values and adjustment parameters and time registration);
- Documentary records of the technological process conditions and updating the date base of the object under test;
- Effective self - diagnostics of the system including current control of the hardware/software state and displaying of error messages.

III. ASSI GENERAL VIEW

The general view of the program system is shown on fig. 1 in a hierarchical structure on two levels: operator's station and controlling microcontroller.

3.1. Software of the Operator's Station

It helps the automation of the preparation procedure of the tests and processing of the results. The software is developed and set for operation in WINDOWS environment.

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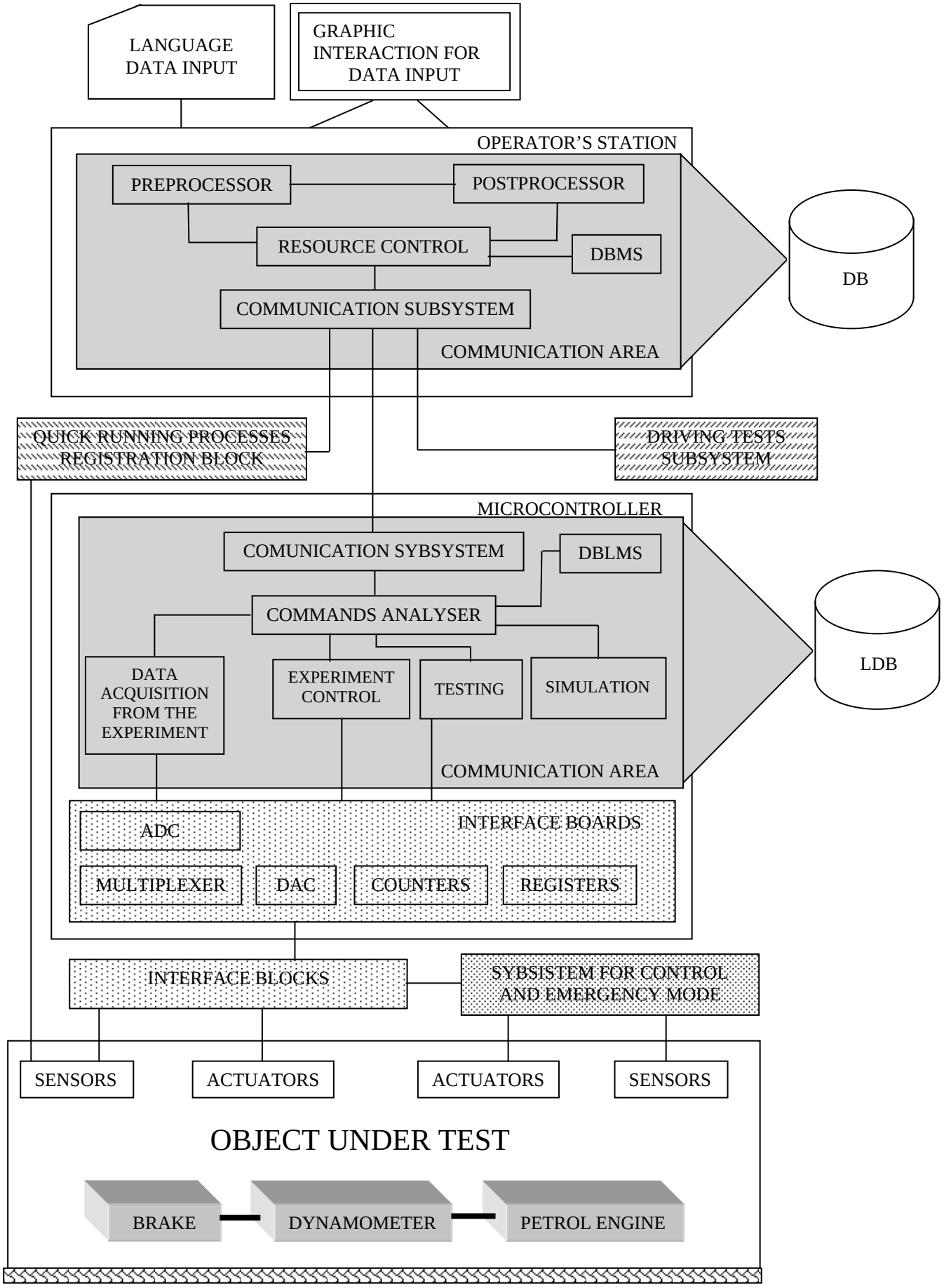

Fig. 1 Architecture of Automated System Software

By means of the pre-processor are given the sequences of operations for carrying out of the testing, for determining the facilities and resources leading to effective achievement of tests' goal. The information referring to the aim, test tasks and the additional data for planning are entered by means of an input language for operation in a scenario mode or interaction mode.

The post-processor implements the visualization both of the input data and the results obtained. It formats all the necessary protocols of the testing, its printing and plotting of the graphic information.

The communication area includes the entire information of the system: - input and invariable data; information as a consequence of pre- and post- processor operation; results acquisition. The information in this area is accessible for all modules using the Data Base Management System (DBMS).

The system applied in this research is dBASE for WINDOWS. The operator's station is in connection with the other units of the system via the following interface buses: specialized parallel bus; interface bus for successive data transmission through line RS 232C; general purpose interface bus (GPIB) - IEE 488.

The connection of the operator's station with the subordinate microcomputer can be made using one of the three above stated interface buses.

3.2. Software of the Subordinate Microcontroller

The software of the subordinate microcontroller is composed of the following basic modules: module for data acquisition form the experiment; experiment control module; testing and simulation modules. All modules communicate via communication area. The invariable information is organized in a Local data base (LDB).

The communication area of the microcomputer includes the entire local information of the system: the invariable data, internal logical keys (flags), internal arithmetic variables, values of timers, etc., as well as the results obtained by the time of their transfer to the operator's station. The information of this area is accessible for all modules using the Data Base Local management System (DBLMS).

The simulation subsystem is designed for of different disturbances, control actions, for obtaining and maintenance of the desired scheme of imitation that determines the technology of testing. The subsystem for monitoring and emergency operation is independent and uses the information from the common sensors and its own (availability of flowing water through the brake, outlet eater temperature after the brake, availability of cooling liquid in the engine, luboil pressure, extreme temperatures, etc.) and actuators for initiations of different interlockings of the engine on emergency.

For driving test subsystem the car is equipped with a special microcomputer (PAD). Prior to the tests it is necessary to enter the results should be transferred to the post-processor of the processing station.

IV. Conclusion

The comparison of the developed ASSI with similar systems is not a simple and easy solving task, because the comparison criteria are not uniform, they concern different aspects, starting with the modes of operation and duration of the testing procedure. It is difficult to generalize and present all comparison criteria by a single criterion of a concrete mathematical expression.

The system can be used both in the practice and research area. It can be also used for investigation of other types of engines, e.g. diesel engines. Then it is necessary to provide additional equipment, invl. suitable sensors and actuators. No need to make any changes in the software package.

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