

ANNEX 2

STANDARD TEMPLATE

QUARTERLY UPDATES

Name of the Asia-wide Programme :	Asia-IT&C Programme
Contract reference no.:	CN/ASIA-IT&C/002 (88667)
Project Title:	CyberC3: Cybernetic Technologies for Cars in the Chinese Cities
Name of Beneficiary:	Research Institute of Robotics, Shanghai Jiao Tong University
Period covered by this Quarterly Update:	2006.03 – 2006.05
Due date of this Quarterly Update:	14 June 2006
<i>Project Budget</i>	<i>669.287,00 EUR</i>
<i>Funds Disbursed by Commission to date</i>	<i>320.000,01 EUR</i>
<i>Expenditure Incurred by Project to date</i>	<i>392.272,00 EUR</i>

I. Introduction

The CyberC3 Project officially started from the 1st of December 2004. In the last three months, the following activities have been implemented:

- Development of the CyberC3 vehicles, progress have been made in HMI, electro-mechanical reconstruction, the control system, vision guidance system, etc;
- Implementation of the pilot application in the Oriental Land, great progress have been made in the communication system, the central control system, and the station system, infrastructure reconstruction, etc;
- Maintenance of the Project website in both English and Chinese;
- Dissemination of the Project results to the public through website, leaflets, papers, news presses, and Video CD.

The difficulties encountered in the last three months are mainly with the electro-mechanical reconstruction of the 2nd CyberC3 vehicle. Together with the delayed funding problem in the last year, the overall progress of the Project has been influenced. The production of three CyberC3 vehicles has to be postponed, and also the pilot application in the Oriental Land.

II. Implementation of Activities

According to the initial work plan and logical framework, the following activities have been implemented in the last three months, and some results have been achieved:

- **Development of the CyberC3 system**

Progress has been made in the development of the CyberC3 system by all partners, including:

1) Electro-mechanical Reconstruction Module:

- a) The 2nd CyberC3 vehicle has been reconstructed, including both electrical and mechanical system;
- b) A new auto-registration method based on encoder has been designed and implemented, in order to improve the reliability and to solve the slip problem;
- c) The power system has been refined in order to supply more steady power;

- d) New cameras for vision guidance and surveillance have been selected and installed on the 2nd vehicle;
 - e) Some relay boards, power boards, connecting boards, and I/O adapter boards have been made for the 3rd and 4th vehicles;
 - f) Hardware and software of 1st vehicle has been refined, in order to be in accord with other three vehicles;
- 2) Control Module:
- a) Hardware architecture has been redesigned on the 2nd vehicles in order to avoid the electromagnetic interference. Two DSP boards are used for speed control and for steering control, respectively;
 - b) Calibration of the wheel encoder and the driving encoder has been done on the 2nd vehicle;
 - c) Software on DSP has been refined and optimized;
 - d) USB based communication between DSP and laptop has been implemented;
 - e) A new remote control terminal based on Palm TX has been designed and implemented;
- 3) Visual Guidance Module
- a) Software architecture has been redesigned according to requirements in the pilot application in the Oriental Land;
 - b) Lane following algorithm has been redesigned according to the special requirements in the pilot application in the Oriental Land;
 - c) A new texture based vehicle localization method has designed and implemented, including video capture, camera calibration, image processing, image matching, CAN communication, fusion with odometry by EKF, etc. Several image matching algorithms, such as gray-correlation based matching, feature based matching, have been tested and compared;
- 4) Laser Guidance Module
- a) A method calibrating installation of laser scanner to make it horizontal has been proposed;
 - b) Technical report on laser guidance has been amended systematically;
 - c) A RS-422-to-USB converter based on DSP has been designed and implemented for laser radar;
- 5) Collision Avoidance Module
- a) A multi-target tracking algorithm using Kalman filters and Probability Hypothesis Density (PHD) filter approach was under development;
 - b) A vision-based pedestrian detection system has been implemented and tested by ISR. The algorithm uses Haar-like features and an AdaBoost based learning algorithm;
 - c) Development of GMM-Classifer (Gaussian Mixture Models) module for Multi-target detection and tracking system by ISR;
- 6) Path Planning Module
- a) Software architecture has been redesigned according to the special requirements in the pilot application in the Oriental Land;
 - b) One emendation path following algorithm has been studied and simulated;
 - c) Development of a trajectory planning method which integrates a speed profile planning for respecting Human comfort Travel by ISR;
 - d) Development and testing of a new Sliding-Mode based trajectory-tracking controller by ISR;
- 7) HMI Module
- a) LED display controlled by DSP has implemented and installed on the vehicle.

- **Implementation of the Pilot Application**

Great progress has been made in the development of the CyberC3 system by SJTU, including:

- 1) Central Control System
 - a) Layout of the pilot application in the Oriental Land has been made;
 - b) Hardware system has been designed, including the office, the power system, etc.;
 - c) Software for surveillance has been designed and implemented;
 - d) Software for fleet management has been design and implemented;
 - e) A new calling method based on SMS has been designed and implemented;
- 2) Station System
 - a) LCD display based on ARM has implemented and tested;
 - b) Half duplex voice communication between stations and the Central Control System has been implemented using the UDP protocol. A driver for UDA1341TS audio codec on uCLinux has been developed and tested on the ARM. Software on PC has also been developed;

- c) A HMI panel at station has been designed;
- 3) Communication System
 - a) Hardware and software architecture has been designed, including the remote surveillance;
 - b) Communication among the Central Control Center, vehicles and stations has been tested in the campus and the Oriental Land, under different conditions, for example, on the moving vehicles, with occlusions by trees and buildings, etc;
 - c) Remote surveillance has been test in the campus and the Oriental Land;
- 4) Infrastructure Construction
 - a) Researchers from SJTU have visited the Oriental Land several times, to study the site of the pilot application and to discuss with the site manager;
 - b) Construction scheme has been drafted with the Oriental Land, including the navigation infrastructure (lane markings), the central control office, the garage, the electrical energy supply system, etc.

- **Maintenance of the Project Website**

The Project website in both English and Chinese has been updated several times. For detail, see: <http://cyberc3.sjtu.edu.cn/>

- **Dissemination of the Project results**

Project results have been disseminated to the target groups and the public through project website, leaflets, newspapers articles, TV videos, and Video CD, in order to enlarge the influence of cybercars in China and speed up the application of cybercars in Asia:

- 1) Three papers have been accepted by the IEEE ISTC'06:
 - a) Dynamic Fleet Management for Cybercars;
 - b) A Multi-target tracking and GMM-Classifer for Intelligent Vehicles;
 - c) Trajectory-planning with embedded velocity planner for fully-automated passenger vehicles;
- 2) One Chinese paper titled "A Magnetic Sensing System for Outdoor Mobile Robot Navigation" has been submitted to Robot;
- 3) One paper titled "Vision-based Pedestrian Detection using Haar-Like features" was presented at Robotica 2006 - Scientific meeting of the 6th Robotics Portuguese Festival, April-May 2006, Portugal;
- 4) One Chinese paper titled "Landmark Based Localization of Intelligent Vehicle" has been submitted to Journal of Shanghai Jiao Tong University.

Two main difficulties encountered in the last three months are with the electro-mechanical reconstruction of the 2nd CyberC3 vehicle.

- Firstly, the Suzhou Eagle Electric Vehicle Manufacturing Co., Ltd., who is the provider of the vehicle bodies for the CyberC3 project, changed the mechanical parts in the steering system. Since our existing mechanical reconstruction method for steering can not work on the new vehicle body, we have to redesign the mechanical system for steering and to test it on the 2nd CyberC3 vehicle, which took more than 3 months.
- Secondly, we changed the location of the on-board electrical system on the 2nd vehicle during reconstruction for the same reason as above. Unfortunately, electromagnetic interference occurred during testing. Therefore, we have to spend another several months redesigning the control system to overcome this problem. Now, this problem has been solved by using two DSP boards to control the steering and speed, respectively.

Together with the delayed funding problem in the last year, the overall progress of the Project has been influenced. The production of three CyberC3 vehicles has to be postponed, and also the pilot application in the Oriental Land.

III. Partnership

During the last three months, the main role of each partner in implementing the activities is:

- All partners were involved in the development of the CyberC3 vehicles, where SJTU was involved in the development of all modules, INRIA was involved in the Visual Guidance Module, Collision Avoidance Module, ISR was involved in the Magnet Guidance Module and Obstacle Detection Module;
- SJTU was in charge of the pilot application in the Oriental Land (Shanghai);

- SJTU was in charge of the maintenance of the project website;
- SJTU was in charge of the dissemination of the project results.

IV. Methodology

The methodology applied in this Project is same as the one described in the Application Form (Annex I). Prof. Ruqing Yang from SJTU was appointed the Project Manager, and assembled the Steering Committee in the beginning of the Project, which comprised key staffs from all the partners.

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