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TELEPRESENCE SYSTEM WITH TRACKED VEHICLE

TELEPREZENČNÍ SYSTÉM S PÁSOVÝM VOZIDLEM

Abstract

The paper involves the creation of a telepresence system composed of a small tracked vehicle with mounted camera platform. The camera is capable of sending live video images to a ‘home site’. The tracked vehicle and the camera are capable of being controlled remotely from the home site. At the home site the system operator is able to use a fixed bicycle to steer and control the vehicle. Pedalling is controlling the speed of the vehicle and the handlebars are used to direct the vehicle. The video image is displayed on the head mounted display the operator is wearing at the home site.

The vehicle was created and tested in Telepresence laboratory of Department of Design Manufacture and Engineering Management at Strathclyde University in Glasgow.

Abstrakt

Příspěvek se zabývá tvorbou teleprezenčního systému sestávajícího z malého pásového vozidla s připevněnou kamerovou platformou. Kamera umožňuje zasílání video signálu na ´domácí stanoviště´. Vozidlo a kameru je možno ovládat dálkově z domácího stanoviště. Na tomto domácím stanovišti je operátor, který může vozidlo ovládat pomocí zafixovaného jízdního kola. Video signál je mu přitom zprostředkováván pomocí přilbového displeje který nosí.

Systém byl vytvořen a otestován v Teleprezenční laboratoři Department of Design Manufacture and Engineering Management na univerzitě Strathclyde v Glasgow.

[1] 1 INTRODUCTION

The basis of this project is a tracked vehicleConstruction is plastic/metal. Plastic track segments are connected by metal pivots.

Movement of the tank is provided by two electro motors (each one driving one track through a gearbox). Part of the model is a digital twin motor differential control unit Tamiya T03 and a 5 channel micro FM receiver (using 40MHz frequency) Futaba FP-R115F. With this equipment, the model can be controlled by any 4 channel transmitter using same frequency. The unit is powered by 7.2V, 1.7Ah Ni-Cd battery pack.

For the control we are using Futaba Skysport4 radio control system, which is a 4 channel radio transmitter used mainly for control of airplane models.

As a ‘home site’ we are using a bicycle mounted on a stand so it is fixed. Frontal wheel is removed. Back wheel is able to move freely as it is lifted in the air.We decided to use a head mounted display used previously for another project.

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2 REALIZATION

Creation of the vehicle was divided into three main tasks, which are corresponding with names of next chapters.

2.1 Video signal

First issue was to mount a camera on the tank and establish a connection between it, and the head mounted display wirelessly. For taking the video signal, we used RS components camera PG-115/110. We are using only four pins from CN1 connector.

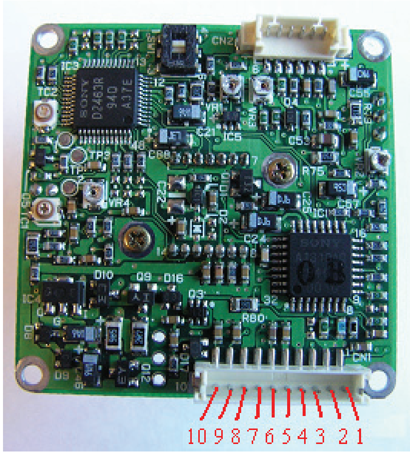

Fig. 1 Camera (back wiew)

Number 7 and 8 are source of the video signal and were attached to standard video connector. Number 4 and 5 are used for powering the camera. They are attached to a 9.6V NiCd battery pack through a switch. The camera is protected by a plastic box and attached to the frontal part of the tank turret.

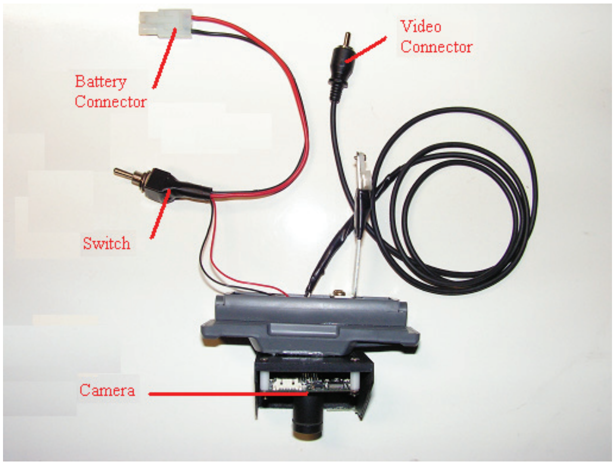

Fig. 2 Camera set

The camera is then connected to an Audio/Video wireless transmitter Response TV AVS PLUS which is using a radio signal on 2.4GHz frequency. This unit is powered by the same 9.6V NiCd battery pack as the camera. The signal is than sent to a twin receiving unit, doubled and distributed to the head mounted display at the home site. The receiver and display are powered by 12V adapters.

The head mounted display contains two small screens (for one eye each) and as we only use one camera, this is the reason why the signal is divided so each screen is supported by the same video feed.

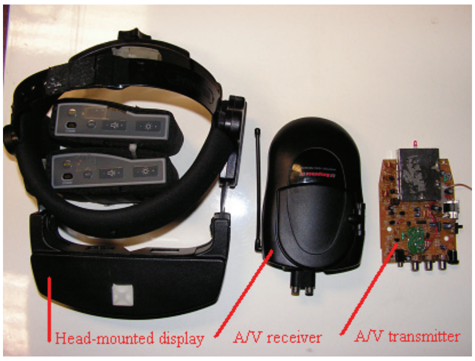

Fig. 3 Transmitting and display unit

One of the objectives was the ability to tilt the camera up and down. This was the reason why we attached the camera on the frontal part of the turret. This part can be assembled with the rear part of turret in a way that it can be moved up and down in a limited angle on two pivots. For realization of this movement we used a servo Hitec HS 300 commonly used in airplane models. As we have a 4 channel radio and receiver in the tank and we need only two channels for actual movement we were able to control the tilt by one of these channels. The shaft of the servo is attached to the frontal part of turret while the servo itself is swivel attached to the rear part. In this way we are able to tilt the camera up and down.

2.1 Speed and directional control

With knowledge about insides of the remote control, we knew that best way to control the speed of the vehicle was to get an output of potentiometer related to the speed of pedalling. The obvious problem was the fact that rotary potentiometers can only work with limited angle, while the pedalling can continue infinitely. Now we were standing between two options. First option was to use another sensor, possibly a tachogenerator and try to transform the signal into needed form. Second option was to use some mechanical device to transform the infinite rotary movement into rotary movement in limited angle relatively to the speed of the rotation. Finally we decided for the later option.

As we know from the basics of movement mechanics, part of the force on a rotating object is a centrifugal force. This force is relative to the speed of rotation and thus it is the one we wanted to use. With this knowledge, we were able to come up with simple mechanical device schematically shown on figure 4.

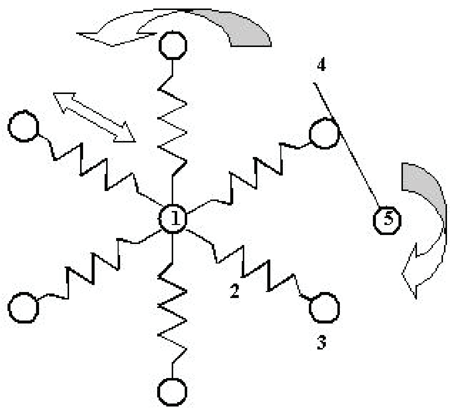

Fig. 4 Transmitting and display unit

Now as you can see on the schematic: The central part (1) starts to rotate. There are several weights (3) connected to it by springs (2). The higher the speed of rotation the bigger is the centrifugal force stretching the springs. The weights are pushing a lever 4, which is connected to the potentiometer (5). By means of this mechanism, we are translating the movement mechanically to a form we need.

Next we created drawings of this mechanism and manufactured it. The real mechanism consists of plastic disc which is limiting the movement of weights, six metal weights with springs, a metal shaft with plastic cylinder, a frame, lever mechanism, and a potentiometer

Unlike the previous speed control described above, the movement of handlebars is easily measured by potentiometer and the same thing can be said about the camera tilt. The direction control involved simply connecting the shaft of the potentiometer to the axis of the handlebars and attaching the potentiometer body to the frame of the bike. Similarly the camera tilt control is provided by a simple lever mechanism attached to the handlebars.

The final task was to link all previously described parts into one whole. Or two respectively, as the project consists of two parts: the home site and the remotely controlled vehicle.

The vehicle itself is linked as shown on figure 5. Power for the vehicle and all other systems inside is provided by two batteries. One 7.2V Ni-Cd battery (7) is powering the electromotors (2) through digital twin motor differential control unit (3) dependently on input signals given by the micro receiver (4), which is also controlling the servo (6) used for camera tilt. The camera (1) is connected with video transmitter (5) by a video cable. Both of them are powered by the second 9.6V battery (8).

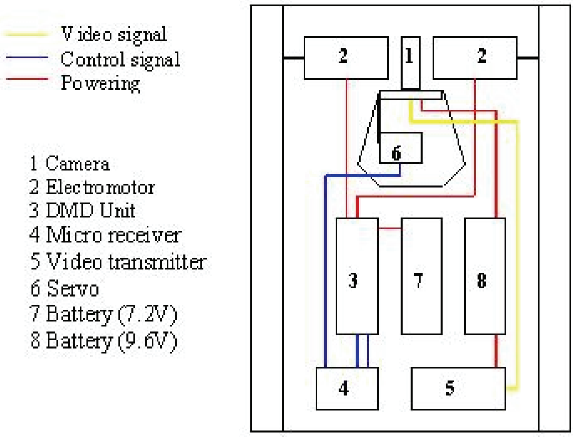

Fig. 5 Vehicle linking

The Home site consists of two separate parts: the control and the display units as shown on figure 6.

The control unit is the bicycle with equipment used for moving the vehicle. The basis is a fixed bicycle. The control signal for vehicle is created by a digital proportional radio control system board (1). This board is getting signals from the speed sensor (2), direction sensor (3) and tilt sensor (4) as described in chapters 2.3. - 2.5., and sending commands through antenna (6). Whole system is powered by one 9.6V Ni-Cd 700mAh Ni-Mh battery pack (5).

The display unit consists of a video receiver (10) which is getting video signal from the vehicle. The signal is then divided and sent by video cable to two A/V boxes (8). Each one of them is providing video feed for one display in the head mounted unit (7). Both A/V units are powered by 6V from an adapter. The receiver is powered by 12V adapter.

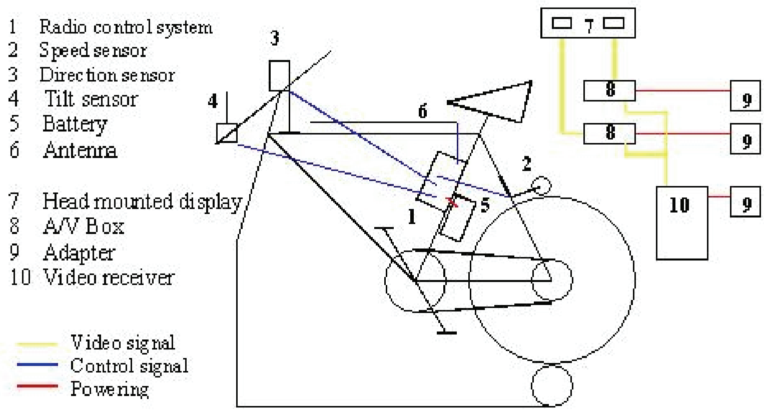

Fig. 6 Home-site linking

3 CONCLUSIONS

The outcome of this project is a remotely controlled vehicle with attached camera, which can be controlled remotely by a bicycle. The main purpose of this project was to show another options of remote control than the standard ones like a joystick or steering wheel. The application can be used as an example for students and it can be further developed by them. It was also a good experience and fun for me to create it. During the work on this project we had some ideas of what can be done next.

We would like to connect the home-site to internet and add the possibility to watch the video through a web browser. Another interesting task would be to control the vehicle also through internet.

Fig. 6 Complete project

REFERENCES

[1] RAMON, P-A; WEBSTER, JG. 2001. *Sensors and signal conditioning*. New York : Wiley., 2001, 587 pp. ISBN 0-471-33232-1.

[2] ELGAR, P. 1998. *Sensors for measurement and control*. Essex : Longman., 1998, 168 pp. ISBN 0582357004.

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