KONTROLA AUTONOMNOG MOBILNOG ROBOTA IZ WEB OKRUŽENJA SA VIDEO STREAMOM

WEB BASED REMOTE CONTROL OF MOBILE ROBOT WITH VIDEO STREAM FEEDBACK

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Sadržaj — ***Web tehnologije menjaju proces edukacije u robotici. Uz pomoć laboratorija za daljinsko upravljanje na bazi web tehnologija korisnik je u interakciji sa procesom kretanja mobilnih robota preko interneta. Upravljanje kretanja mobilnih robota je danas veoma atraktivna istraživačka oblast kako iz aspekta teorijskih istraživanja tako i iz aspekta praktične primene. U radu se prikazuje daljinsko upravljanje mobilnih robota na točkovima pri kretanju u nepoznatom okruženju sa preprekama. U radu objekat upravljanja je mobilni robot Scribbler od Parallaxa. Mobilni robot ima dva pogonska točka i upravljanje se ostvaruje promenom ugaonih brzina pogonskih točkova. Kada se mobilni robot kreće ka cilju u nepoznatom okruženju, a senzori mobilnog robota detektuju prepreke, tada se mora postaviti upravljačka strategija u cilju izbegavanja kontakta između mobilnog robota i prepreka.***

Abstract — There has been a tremendous increase of interest in mobile robots. Today, however, we can build small mobile robots with numerous actuators and sensors that are controlled by inexpensive, small, and light embedded computer systems that are carried on-board the robot. The simplest case of mobile robots are wheeled robots. The goal of this article is to get students interested in and excited about the fields of engineering, mechatronics, and software development as they design, construct, and program an autonomous robot.

Keywords – distant monitoring, remote control, embedded system, Scribbler

I. INTRODUCTION

One of the main advantages of Scribbler developing environment is the ability to monitor and remote control any of the Scribbler's from a host PC. For that purpose, a remote control program has been implemented. The host system connects to the mobile robot with the Bluetooth module. A number of interfaces are available on most embedded systems. These are digital inputs, digital outputs, and analog inputs. DC motors are usually driven by using a digital output line and a pulsing technique called "pulse width modulation" (PWM). The differential drive design has two motors mounted in fixed positions on the left and right side of the robot, independently driving one wheel each.

II. SCRIBBLER

The Scribbler robot is a great tool with which to get started with robotics. The eb500 module makes it possible for the Scribbler's BASIC Stamp 2 microcontroller brain to communicate wirelessly with Microsoft Robotics Studio running on a nearby PC. The BASIC Stamp microcontroller runs a small PBASIC program that controls the Scribbler's servos and optionally monitors sensors while it communicates wirelessly with Microsoft Robotics Studio.

Figure 1. Assembled Scribbler

III. SENSORS AND ACTUATORS

There are a vast number of different sensors being used in robotics, applying different measurement techniques, and using different interfaces to a controller. Very important thing is to find the right sensor for a particular application. In this case an infra red sensor was used.

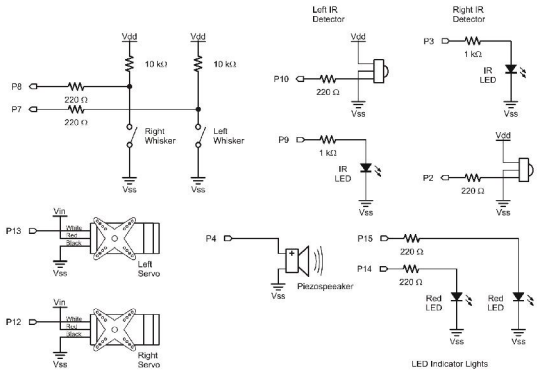

Figure 2. Sensors and actuators

Binary sensors are the simplest type of sensors. They only return a single bit of information, either 0 or 1. A typical example is a tactile sensor on a robot, for example using a micro switch. Interfacing to a microcontroller can be achieved very easily by using a digital input either of the controller or a latch.

DC electric motors are arguably the most commonly used method for locomotion in mobile robots. DC motors are clean, quiet, and can produce sufficient power for a variety of tasks. Standard DC motors revolve freely, unlike for example stepper motors. Motor control therefore requires a feedback mechanism using shaft encoders. The first step when building robot hardware is to select the appropriate motor system. The best choice is an encapsulated motor combination comprising a DC motor, Gearbox and Optical encoder.

IV. WIRELESS COMMUNICATION

Bluetooth is a technology intended for connecting devices which can be found within a relatively small distance from each other (initially this technology was imagined to be functioning within a perimeter of 10 m). Bluetooth was created to replace the cables. It is used for so-called ISM frequency range (2.4 GHz intended for industry, medicine and science).

Figure 3. The eb500 Bluetooth module

Being only an internal code name first, Bluetooth became an official trademark later. The name Bluetooth derives from the Viking king Harald Blåtand, who united Norway and Denmark in the 10th century and brought Christianity to Scandinavia. The Viking word 'Blåtand' translates to 'Blue Tooth' and refers to Harald's dark complexion rather than the folklore story of his affection for blueberries. According to his unification of two countries, the SIG founders believed Bluetooth to be an appropriate name for the unification of the companies in that project. Bluetooth is an industrial specification for low costs short-range wireless networks. In 1994, Ericsson Mobile Communications started a study to find a low power and low cost solution to replace cable connections between mobile as well as fixed devices, such as a laptop and a printer. The solution had to match special criteria's of cost, performance, size and power consumption to also fit in small battery-powered portable devices, i.e. cell phone. Beside this the transmission of both data and speech had to be realized. To make Bluetooth to a worldwide standard, Ericsson Mobile Communications, IBM, Intel, Nokia, Toshiba founded the Bluetooth Special Interest Group (SIG) in September 1998. The SIG developed the Bluetooth wireless technology and standard to be interoperable between different devices of different producers. The group growed larger and counts over 2000 membership companies today whom are allowed to use the open platform technology. The Bluetooth core specification, covering the physical layer and the data link layer, was adopted by IEEE under the name WPAN (Wireless Personal Area Network) and can be found in IEEE 802.15.

V. EXPLORATION AND NAVIGATION

In the landmark-based navigation system, the robot operates in two modes: exploration and navigation. In exploration mode, the robot explores the environment using a depth-first search among the unvisited landmarks. A visibility edge between two landmarks can be traversed by visual servoing, using the real-time recognition algorithm. At every newly-visited landmark, the robot scans for all landmarks visible from this position, records their relative angles and estimates of their distances, and starts an observation history for this landmark. The landmarks all have unique markers which are used as node labels in the graph. As mentioned above, in the process of exploring, the robot replaces distance estimates with more accurate odometry measurements. Also, as landmarks are revisited during the exploration phase, the observation histories are updated and the probability estimates are refined. Once part of the environment has been explored, the robot can enter navigation mode, and accept navigation tasks from the user. For a given goal, the expected shortest paths are computed and used for path planning as described above. Navigation mode and exploration mode can be interleaved seamlessly, length and probability factors are continuously updated in both modes based on observations made and edges traversed. In summary, this navigation system is able to operate robustly in the presence of unreliable sensory input_ and can

cope both with the temporary occlusion of landmarks and with permanent changes to the environment, such as the removal and addition of new landmarks.

VI. 3. DISTANT MONITORING

The first input level in the system is the movable web-cam. This web-cam is connected to a PC over the USB. The picture is observable through the PC. The software used for the web cam is Broad Cam software, it makes broadcast via internet, sends picture and voice.

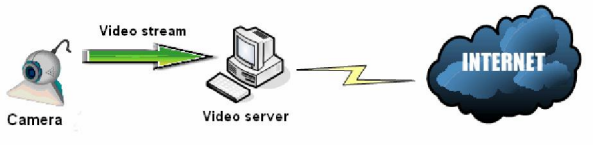

Figure 4. Figure 4. Distant monitoring

The Broad Cam software samples the picture, compacts the data, controls the bandwidth, and also broadcasts the video signal over the internet. The software Broad Cam first creates a video server after the start, opens the TCP port, starts the web-cam and transmits through the port picture. Other PC computers can receive this picture. The public IP address enables the full availability for all users from all places.

VII. SOLUTION

In this project we have used a Bluetooth module to achieve remote control over a Scribbler. We used the Bluetooth base station to read a file from the controlling computer and send its contents to the second Bluetooth module. The second Bluetooth when receiving the data in turn opens up its outputs depending on what it received. These outputs control the speed of the wheels individually.

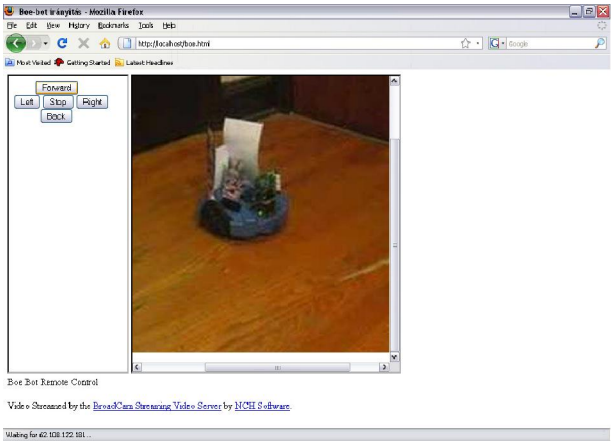

Figure 5. The web interface

Users can watch the on-line videos provided by the web camera. With obstacles present in the unknown environment, the mobile robot reacts based on both the sensed information of the obstacles and the relative position of the target In moving towards the target and avoiding obstacles, the mobile robot changes its orientation. When the obstacle in an unknown environment is very close, the mobile robot slows down and rapidly changes its orientation.
The navigation strategy is to come as near to the target position as possible while avoiding collision with the obstacles in an unknown environment.

VIII. CONCLUSION

Robotics has come a long way, especially for mobile robots. In the past, mobile robots were controlled by heavy, large, and expensive computer systems that could not be carried and had to be linked via cable or wireless devices. Today, however, we can build small mobile robots with numerous actuators and sensors that are controlled by inexpensive, small, and light embedded computer systems that are carried on-board the robot. Building and programming a robot is a combination of mechanics, electronics, and problem solving. What you're about to learn while doing the activities and projects in this text will be relevant to "real world" applications that use robotic control, the only difference being the size and sophistication. The mechanical principles, example program listings, and circuits you will use are very similar to, and sometimes the same as, industrial applications developed by engineers.

IX. REFERENCES

Acknowledgements: This research was partially supported by the TAMOP-4.2.2/08/2008-0008 program of the Hungarian National Development Agency.

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