

Intelligent Cane Robot For Walking Assistance of Elder and Handicapped People

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Abstract: *The main aim of the project is to design "An intelligent cane robot" for aiding elderly and handicapped people's walking. Our system is designed by using ARM 32bit micro controller which supports features for the development of cane robot. Our robot is used as a support for elders and for handicapped people. Our system contains ultrasonic sensors and IR sensor and motors for controlling movement. We use three ultrasonic sensors placed at three directions of robot which detects leg movement of person then based on that leg movement robot direction gets changes. If a person tries to move straight the ultrasonic sensor detects his leg movement then simultaneously cane robot also moves one foot forward. If ultrasonic sensor connected at sides detects leg movement then it changes one foot either left or right direction. The IR sensor is connected to robot at front which is used to detect obstacles in front. When it detects obstacles in front of it then it automatically stops movement of robot. Motors connected to controller are used for robot movement. For holding stick by person we use cane through this movement is controlled.*

Keywords: Sensors, cane robot, ARM, dc motors, line drivers

INTRODUCTION

More number of people aged in next generation due to yearly increasing aged people ratio compared to other people. An on average only 10 % are aged now, and it is estimated to reach 21% in 2050. Loosing complete or

part of mobility, affects not only the ability to walk but also the effect on daily life, that is a major determinant in life quality and causes dependence of others in daily life.

In an aging society it is extremely important to develop devices, which can support and assist the elderly people by moving robot in his intentional direction. Elderly tend to have cognitive impairments and experience more serious falls but there is strong evidence that daily exercise may result on fall prevention and postural stability. So, it becomes more and more relevant to find ways and tools to compensate to improve or to restore and to enhance this mobility [4]. Intelligent cane robot is to perform optimized actions to help the user's walking or facilitate their recovery. The sanctions include "guiding," "fall pre-venting," "rehabilitation training," and so on. To provide these optimized actions, one of the most important tasks that should be accomplished by the robot is to correctly estimate the user's walking intention by his leg moment. From the viewpoint of the robot control system, the user's walking intention of the leg provides the robot motion controller. Therefore, in this paper focus on the design of robot motion control strategy, in which the user's walking intention should be explicitly find by his leg moment this control strategy plays an important role in the design

System Architecture

The S3C2400 was developed using an ARM920T core, 0.18um CMOS standard cells and a memory complier.

Its Low-power, simple, elegant and fully static design is particularly suitable for cost-sensitive and power sensitive applications. Also S3C2400 adopts a new bus architecture, AMBA (Advanced Microcontroller Bus Architecture) An outstanding feature of the S3C2400 is its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd. The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length.

Ultrasonic distance sensors consist of 3 major parts: A transmitter, a receiver and a timer. To measure a distance, the timer triggers the transmitter which emits a series of pulses, then the timer waits until the receiver detects the reflection of the pulses and stops the timer. The time measured is then divided by 2 and multiplied with the speed of sound. The result is the distance between the sensor and the object in front of it. The transmitter sends out a stream of pulses on a carrier frequency. The maximum frequency humans can hear is about 20 KHz. A frequency higher than that is picked to avoid annoying humans with the constant beep -- 40 KHz is a common value. The receiver triggers when it receives a signal with that particular frequency. This is not necessary the signal the transmitter sent. If more than one ultrasonic sensor with the same carrier frequency are used, they can detect each other's signals.

Sound doesn't move in a straight line, but rather as a 3D expanding wave. When the wave reaches an object part of it bounces back and moves again as a 3D expanding wave in the opposite direction. Such a wave can easily bounce multiple times before disappearing. So it is very possible that you receive pulses that have travel a much larger trajectory than just to and back from the object in front of the sensor. While some part of this problem can be solved by letting the sensor wait some time before starting another measurement, other situation can produce incorrect measurements which are fairly tough to correct. For example, moving through a doorway can fail because the sensors emitted pulses bounce from the walls back to the sensor and so giving a measurement that indicates an object in front of the sensor. One way of correcting this is using another sensor, for example a IR distance sensor to see if there really is an object. However, such solution poses another problem: which

sensor to believe? 3 sensors allow you to go with the majority, but then things become quite complicated in constructing and interfacing such systems, not to mention what it does to the power consumption.

Availability & Range

Sonar sensors are widely available and relatively inexpensive, ranging from \$15 to \$40 depending on the desired range. On average the maximum range of a midlevel sonar sensor will be between 4 and 6 meters. Unlike infrared or laser sensors, sonar sensors also have a minimum sensing distance as well. This is due to the fact that the distance measurements are based on the speed of sound, and over very short ranges the sound travels out and back more quickly than the circuitry can respond. This minimum distance will vary by sensors, but is typically around 2 to 5 centimeters. Also unlike infrared sensors, sonar sensors don't have a perfect "cone" of vision. Because sound propagates as a 3D pressure wave, the sensor actually has a range that resembles a sink function wrapped around a curve.

Potential Problems

Sonar sensors work very well for collision avoidance in large areas, but they do have some limitations. Because sound propagates out as a 3D pressure wave and echoes, your robot may see things that are not really in its way. For instance, near angled walls the sound waves may bounce several times before returning to the sonar receiver. This makes it difficult for the robot to know which echo is actually the correct distance to the nearest obstacle. Similar to this is the problem of having multiple sonar sensors operating in the same area. If the frequencies of nearby sonar sensors are too similar they may cause false readings since the sensors have no method besides frequency to distinguish pulses it sent out from those other sensors send out. Another common problem is the difference in absorbency and reflection of different materials. If you shoot a sonar pulse at a cloth covered wall (i.e. cubicle), it is likely that the cloth will absorb a significant amount of the acoustic energy and that the robot will not see the wall at all. On the opposite end of the spectrum, a floor with very high acoustic reflection may register as an obstacle when it is really a clear plane

The L293D motor driver is available for providing User with easy and user friendly interfacing for embedded application. L293D motor driver is mounted on a good quality, single sided non-PTH PCB. The pins of L293D motor driver IC are connected to connectors for easy access to the driver IC's pin functions. The L293D is a Dual Full Bridge driver that can drive up to 1Amp per bridge with supply voltage up to 24V. It can drive two DC motors, relays, solenoids, etc. The device is TTL compatible. Two H bridges of L293D can be connected in parallel to increase its current capacity to 2 Amp.

Software

Software's are used in ARM micro controllers 3 things are required Boot Loader, Kernel, Root File System the main functionality of boot loader is to initialize all the devices that are present on the arm board kernel is a computer program that manages input/output requests from software into data processing instructions for the central processing unit and other electronic components of a computer. The kernel is a fundamental part of a modern computer's operating system. Root File System will tell how files arrangement there inside the internal standard storage devices Qt[5] is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) and also used for developing non-GUI programs such as command-line tools and consoles for servers. it uses standard C++ and can be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. As Qt is based on C++, it can be easily ported on to different platforms, such as Embedded Linux, Windows

WALKING MODES OF CANE ROBOT

In order to facilitate the development of walking model and control strategy, the cane robot systems is illustrated first. As shown in Table1. To describe the human walking intention during using the cane robot, an important concept is introduced as follows. The direction to which a person intends to move is referred to as the intentional direction (ITD). The ITD can be evaluated by the leg moment between the forward direction and the ITD [2] itself. Obviously, the ITD is a time-dependent value on sensor, the quantity of this intention is characterized by the corresponding sensor

activation along the ITD. To formulate the walking intention quantitatively, it is required to obtain ITD. The first thing we should do is to enumerate possible human walking modes. Although there are plentiful of possible modes during walking, only several of them are often used in the daily life. In this study four simple walking modes are considered, which are listed in Table I. We assume that there are four main types of walking modes including "Stop" (mode I), "Go forward" (mode II), and "Turn left" (mode III), and "Turn right" (mode IV) "in daily life. Furthermore, mode II mostly used. A typical case of human walking mode turns around. Mode is obtained by using mode III or mode IV. During walking, empirically, we know that change of mode may occur

between any two walking modes. Therefore, all possible modes among the four modes are illustrated in Fig3. Walking intention in different walking modes is found by using sensors that are

Interfaced to robot. The current position and posture of cane robot are inferred from the sensory data mounted on the robotic wheels. To ensure the safety of cane robot. The output of motion controller is also restricted by some thresholds, which can avoid the sudden change of robot movement. The state of user is monitored by multiple sensors interfaced to robot. The current position and posture of cane robot are inferred from the sensory data mounted on the robotic wheels. All modes of operations of cane robot function is designed by using h bridge in which depending on the switch positions rotate the robotic wheels

CONTROL SYSTEM OF CANE ROBOT

The intelligent cane robot motion controller uses a sensor to control motion of robot based on the inferred human intention, which is called the Intentional direction cane robot. By utilizing some sensor fusion approaches, the state of user can then be reliably recognized and provided to the motion controller. The cane uses sensors detect mode of operation then the user a "feeling" as if he is interacting with the system specified by the model. This model is defined as a transfer function with the user as the input and the reference cane robot as the output. It is during walking; people feel comfortable if the cane is easily moved in intentional direction then user can feel better. In this system intentional direction is important to which direction movement will be is the first then the

corresponding sensor has to activate and then which direction to move to rotate the robot position. To meet the requirement, we propose scheme in which two models are used. One model is defined for the motion along the intentional direction. The other model is defined for detecting any obstacle in front of the robot. The model for our cane robot is defined as based on the current walking mode, the control diagram of the whole cane robot system is shown in Fig.4 At each control period the interactive sensors between the user and the cane robot is measured by the sensors. The current robot positions are measured by the sensors. Once the position of robot is find then to move left or right rotate robot slightly in intentional direction then drive the robot forward direction all two models designed for robotics is shown in fig.4 finally the robot allocated to the three wheels.

HARDWARE

Figure 6 below shows the Main Board that contains USB connected I/O pins and +5V DC supply. The red indicator LED will light up whenever the supply is served to the board. The LPC2148 is powered by +5V DC supply that is being regulated from the LM7805 voltage regulator. The Main Board also has a pushbutton to reset the program whenever it is needed. Mini24440 is a practical low-cost ARM9 development board, is currently the highest in a cost-effective learning board. It is for the Samsung S3C2440 It is for the Samsung S3C2440 processor and the use of professional power stable core CPU chip to chip and reset security permit system stability. The mini2440 Immersion Gold PCB using the 4-layer board design process, professional, such as long-wiring to ensure that the key signal lines of signal integrity, the production of SMT machine, mass production; the factory have been a strict quality control, with very detailed in this manual can help you quickly master the development of embedded Linux and WinCE process, as long as there is C language based on the general entry to two weeks. To choose the development board startup mode, S2 Dipswitch is determined, Depending on the target board tips. Switch S2 to "_NOR" side logo, the system will start with the NOR flash. Switch S2 to "_NAND" side logo, system will start with the NAND Flash. On-board 64 MB NAND flash, Power-down non-volatile On-board 2 MB NOR flash, Power-down non-volatile, BIOS has been installed The NOR

Flash and NAND Flash of the development board has been burned into the Same BIOS from factory (because the BIOS at the same time support for both flash The Motor Board in the following Figure 7 provides motor control up to three DC motors. The supply power needs two +12V DC supply that connects serially to the motor drivers. One LED to indicate whether the board is being supplied or not is located at the top right of the board while the all the three motors have their own drivers to control all three dc motors

RESULT AND ANALYSIS

The main body of the robot as in Figure 7 was constructed by using various sensors of thick wood. The robot was made within 32cm squared area and 12cm height for Practicality and portability, by using the stick an aged people walk easily All the three wheels of robot aligned to cover all 360 degrees of any area to move a person. The leg moment of cane robot Is detected by ultrasonic sensors inter faced to the advanced risk processor with all the direction covered by using data obtained by ultrasonic sensors. The red indicator LED will light up whenever the supply is served to the board.

CONCLUSION

In this paper, a new Omni directional-type cane robot was developed for the elderly and handicapped people. Motion control of this robot was studied based estimating human walking intention. By using sensors It supports elder an handicapped people by this we will provide rehabilitation for their lower limb problems .The system testing that concerning on the basic and real-time execution has successfully verified the interface functionality between the motor control, IR sensors, ultrasonic sensors and S3c2440 arm9 processor and tested results ,the objectives have been successfully accomplished since the motor can be controlled by leg of a person , an interfacing with the ultrasonic sensors works perfectly .

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