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Modern Cane Enabling Obstacle Detection and Navigation Based on Human Gesture using Voice Board

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Abstract:

There are six sense organs for human being. Out of six sense organs, vision sense is an important sense for human life. But, the people who are visually challenged may find difficulty to lead their daily life. Their difficulty will become a problem when they have an object or an obstacle in front of them. Therefore, a special design of a stick is required for the use visually challenged human to help for their navigation. In this paper, the obstacle detection is proposed to assist the blind people by giving them an ultrasonic aid.

The purpose of this paper is to develop a cane system to give a sense of artificial vision and to detect the objects for the sake of blind people. It is also of low cost and provides efficient navigation assistance. The visually challenged people get information about the surrounding where static and moving objects present. The distance between the blind person and the object is measured by ultrasonic sensors. With that measurement, the blind person can move in the path. The ultrasonic sensor indicates the existence of an object by giving an output of beep sounds which can be heard by the user of the white system.

The increasing advanced technologies must be utilized to get the benefits soon.

The proposed system helps the blind people to avoid collision with others and navigating them according to the obstacles. And also the system consists of sensors to avoid person from falling. This provides the person from falling and provides grip to the person. The indication is provided to the concerned person. The system also provides the stick location indication system and navigation system with gesture based control techniques.

Keywords: *Cane, obstacle, navigation.*

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I. INTRODUCTION

For decision making, the blind people depend on other humans, their pet dogs and other external electronic supporting devices. The present supporting devices help in finding the objects at floor. But, they are unable to indicate their presence at depth and objects above waist level or on stairs. The white cane system overcomes the above said limitations of the existing systems.

The user of the white cane system detects the objects by moving the cane back and forth when the person walks. When the cane touches an object or hits the edge of a stair, the same information is provided to the user by an audio feedback given by ultrasonic sensor. If the white cane stick is misplaced, the radio frequency module is used to take the stick.

A portable unit (cane) is designed and developed in this paper for blind persons to use easily and navigate in public places.The cane is provided with three sensors, namely, ultrasonic sensor, light sensor and water sensor. Ultrasonic sensor, on sensing the objects, using ultrasonic waves, sends the same message to the microcontroller for further processing. After getting information, the microcontroller calculates the distance of the object from the user. If the object is far from the user, the cane system will not respond to it. If the object is nearer to the user, then the microcontroller will send a signal as input to the buzzer and the buzzer will make sound. The light sensor activates the respective buzzer when it senses darkness of the room. The water sensor will make the corresponding buzzer to give sound when cane experiences water.

II. THE PROPOSED SYSTEM

The white cane stick is provided with a force sensor. The force coming out from the user when he falls is sensed by the force sensor. Then the force sensor indicates it to the controller. The Micro Electro Mechanical System (MEMS) sensor is also used. Global System for Mobile (GSM)module transmits a message to the user of the cane. The wheel is used to provide a grip to the user when they are falling. The Gesture board is used to provide data based on different gestures. There are two sensors using ultrasonic waves to find objects as well as potholes in the surface. Based on the obstacles, the voice IC transmits the voice signal on the speaker. The RF transmitter is used to detect the presence of stick inside the home by blind people and thus the proposed system ensures the safety of the user.

III. STICK TRANSMITTER

The block diagram for the stick transmitter is shown in Figure 1

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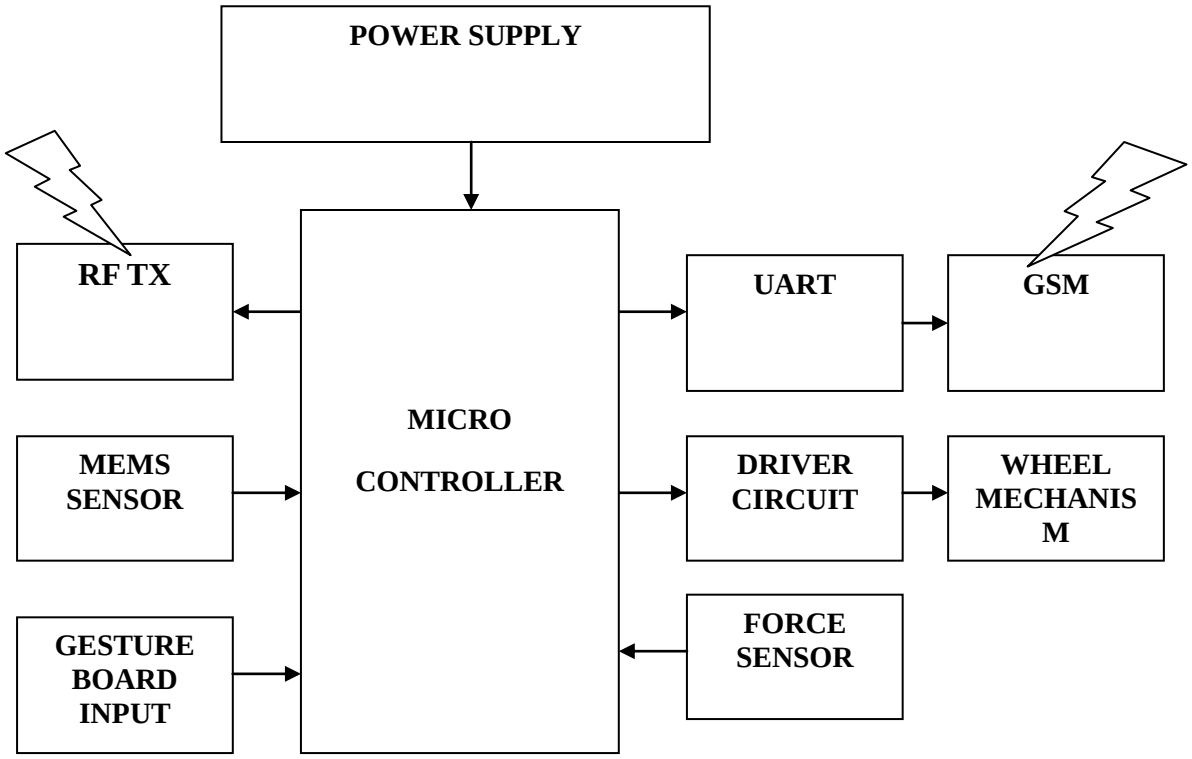

Figure 1. Block diagram of stick transmitter

STICK RECEIVER

The stick receiver is shown in Figure 2

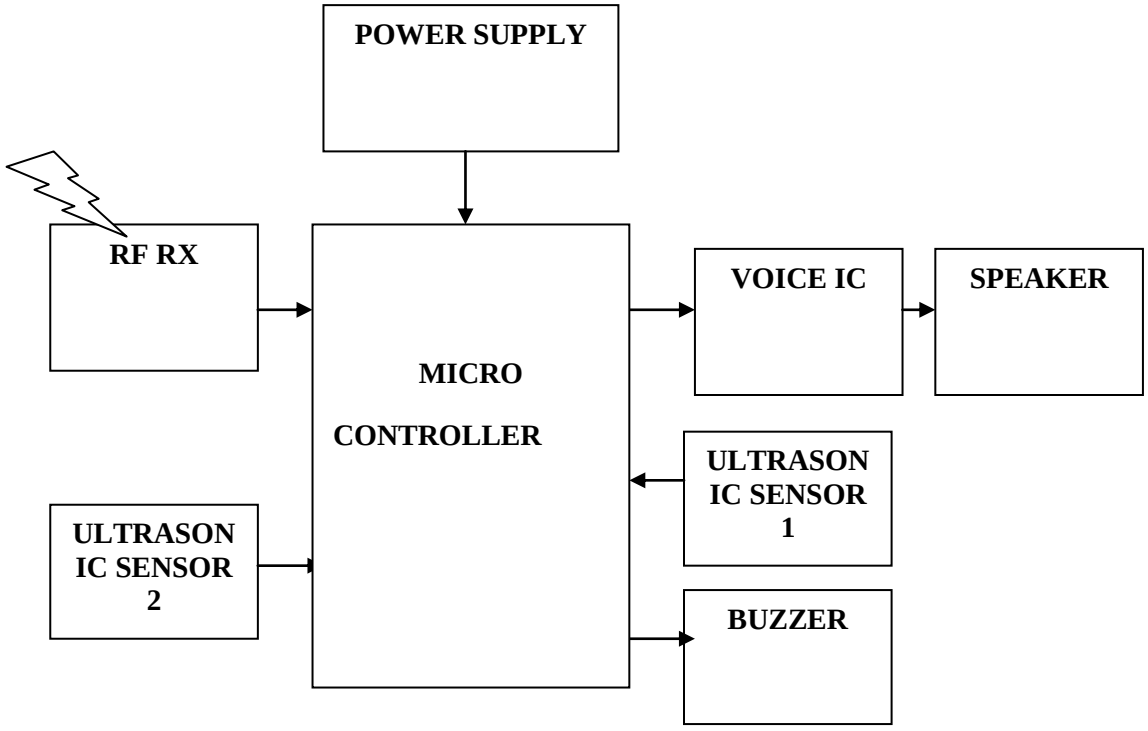

Figure 2. Stick receiver

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STICK DETECTION SECTION

The stick detection section is shown in Figure 3

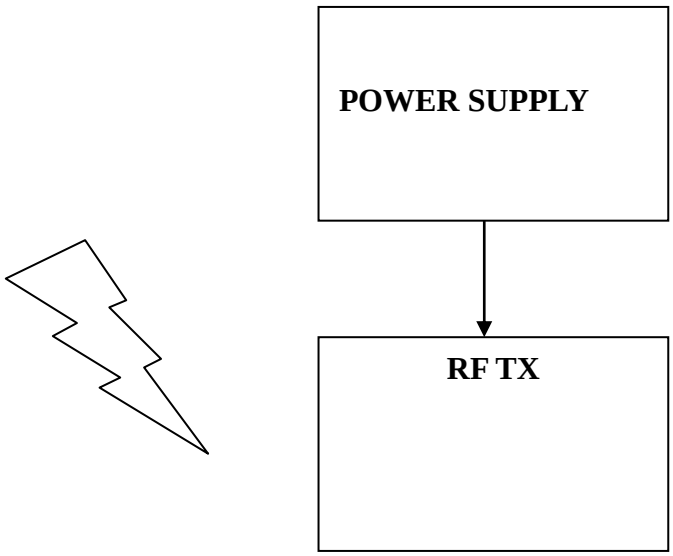

Figure 3. Stick detection section

IV. HARDWAREDESCRIPTION

TRANSFORMER IN POWER SUPPLY

The step down transformer steps down the level of supply voltage in the range from 230Volts to 6Volts. The secondary of the step down transformer is connected to the rectifier which rectifies the transformer output to peak DC output voltage.

BRIDGE RECTIFIER

The type of rectifier used here is bridge rectifier. The diagonally opposite corners of the bridge are supplied with the input. The remaining two ends of the bridge give out the output. The benefit from this bridge rectifier is that it produces a voltage output twice than the output of an ordinary full wave rectifier.

VOLTAGE REGULATOR

The regulators in the proposed system are used to provide standard constant regulated output voltages from 5V to 24V. This regulator circuits consist of reference source, comparator amplifier, control device and circuitry for protection from overload.

PIC MICROCONTROLLER

The proposed system utilizes the PIC microcontroller PIC16F877A. It is simple to use and easily programmable with understandable coding. It can be rewritten with erase option frequently because it uses FLASH memory technology.

FORCE SENSOR

The force sensor is a resistor sensitive to force. The sensing area is round in shape with a diameter of 0.5". The resistance varies depending on the pressure experienced on the sensing area. For harder

force, the resistance of the sensor will be less. The resistance will be high of the order of 1MΩ when there is no pressure applied to sensing area of the force sensor. The sensing area can sense the forceranging from 100g-10kg.Interlink Electronics FSRTM 400 series is included in the single zone Force Sensing Resistor family.

MICRO-ELECTROMECHANICAL SYSTEMS (MEMS)

These sensors can act as an interface. The acceleration and or pressure in the environment can be sensed, processed and controlled by these sensors. These sensors can be built as electrical and mechanical components in a chip.

UNIVERSAL ASYNCHRONOUS RECEIVER/TRANSMITTER (UART)

The main block used for serial communication inside a computer is a Universal Asynchronous Receiver/Transmitter (UART). The UART accepts data bytes and sends each bit sequentially. In the receiver, the same type of UART is provided to re-group the bits and re-assembles them into the original transmitted data bits. In serial communication, a single wire is used to transmit digital bits. So, it is an inexpensive method. But in parallel communication scheme, multiple wires are used so that the system becomes fast and expensive. In full duplex communication system, transmission and reception are possible at the same time. In half duplex system, devices will be made to transmit mode or receive mode.

ASYCHRONOUS PROTOCOL

Transmission and reception of data happen at different times. There is no need of sending a clock signal along with the transmitted signal. But, the transmitter and receiver have accepted timing parameters before the start of transmission. After each word, extra bits are appended to make the receiver synchronized to transmitter. The transmitter transmits (LSB first) 5 to 8 data bits. They are prefixed with a start bit. Data bits will be followed by a parity bit which is optional. Finally, the stop bits are of either 1, 1.5 or 2. This is the method of asynchronous transmission.

The UARTs placed in transmitter and receiver should work in the identical timing parameter, character length, parity and stop bits for correct operation. The serial port field format contained in personal computer normally consists of one start bit, eight data bits, no parity bit and one stop bit.

REOMMENDED STANDARD-232

Recommended Standard 232 (RS-232) is a connector for serial digital data communication between a Data Terminal Equipment (DTE) and a Data Communication Equipment (DCE). It is often connected in personal computer serial communication ports. The level of voltage is different for TTL level UART and RS-232 is the voltage level. Valid signals in RS-232 are ±3 to –±15V. The signal near 0V is not a valid RS-232 level.

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INTERFACING BETWEEN TTL LEVEL UART AND RS-232

Microcontroller uses TTL level UART while the personal computer serial port uses RS-232. UART and RS-232 standards use same protocol for software. TTL level UART and RS-232 use different voltage levels. So, there is a need for a level shifter to interface the TTL level UART with RS-232. The available level shifter IC is the MAX232 from Maxim.

GLOBAL SYSTEM FOR MOILE (GSM)

GSM is a mobile communication modem. It uses a cellular technology to send mobile voices and data. The operating frequency bands are 850MHz, 900MHz, 1800MHz and 1900MHz.

GSM uses time division multiplexing access at transmitter for communication. GSM initially digitizes the data and reduces the data to a predefined level. Then it sends the data through a communication channel with two different streams of client data, each in different time slots. GSM has an ability to carry 64 kbps to 120 Mbps of data rates.

GSM COMPONENTS

Mobile Station: Mobile station means mobile phone system. Mobile is provided with a transceiver, the display and the processor. Mobile is also provided with a SIM card to operate over the network. SIM card controls the mobile.

Base Station Subsystem: The system works as an interface between the mobile phone station and the network subsystem. The mobile base station has the base transceiver station. The transceiver consists of the radio transceivers and works on mobile communication protocols. The transceiver also has the mobile base station controller to control the mobile base transceiver station. The transceiver is as an interface between the mobile station and mobile switching centre.

Network Subsystem: The network subsystem selects the basic network connection for the mobile stations. The main part of the network subsystem is the mobile service switching centre(MSSC).MSSC provides access to different networks like ISDN, PSTN etc. MSSC consists of the home location register and the visitor location register. The visitor location register keeps track of the call routing and roaming capabilities of GSM. It also contains the equipment identity register to have a record on all the mobile equipments wherein each mobile is identified by its own International Mobile Equipment Identity (IMEI) number.

GSM MODEM

The device GSM modem enables personal computers and other processors to have communication over the network. GSM modem is inserted with a SIM card. The network operator subscribes the network range for the modem to operate over. Serial port or USB cable or Bluetooth is used to connect the GSM modem and personal computer.

WORKING OF GSM MODULE

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Interfacing of GSM modem to the microcomputeris done by the level shifter IC Max232. Serial communication is the process through which GSM modem with SIM card find a way to transmit the received data to the microcomputer. The received data is digit command in the form of SMS from any mobile. When the program execution is completed, the command STOP is received in GSM modem. An output is then developed at the microcomputer. The 16×2 LCD display is used to view all the information.

GSM MODEM CIRCUIT

Communication with the world over a network is made possible by GSM mobile. This circuit enables a person to call anyone at any time.

In this paper, SMS is transmitted from sender to receiver by using GSM network. Two subsystems proposed here are appliance control subsystem and security alert subsystem. The home appliances can be controlled from a remote location. This can be enabled by appliance control subsystem. The security alert subsystem is used to monitor the security automatically. Depending on user's needs, SMS from a specific mobile is given to alter the running condition of appliances. When an intrusion is detected, the same is given as security alert. Then the system permits an automatic generation of SMS to alert the user against security risk.

DRIVER CIRCUIT

The ULN2003 is a monolithic high voltage and high current darlington transistor arrays. The driver circuit consists of seven NPN darlington pairs. The high voltage output with common-cathode clamp diode helps to switch the inductive loads. The collector-current rating of a darlington pair is 500mA. The darlington pairs may be paralleled to get higher current capability.

The ULN2003 contains a 2.7kW series base resistor for each darlington pair. It operates directly with TTL or 5V CMOS devices.

ULTRASONIC SENSOR

Ultrasonic sensor transmits ultrasonic pulses. The pulses reach the object and return to the transducer. The time elapse between transmitted pulse and received pulse will be measured.

The sonic waves emitted by the transducer are reflected by the object. The reflected waves are received in the transducer. After the sound wave emission, the ultrasonic sensor will switch to the receive mode. The time elapsed between the emission and reception depends on the distance of the object from the sensor.

The ultrasonic sender sections ends an ultrasonic signal in a particular direction. It starts noting down the time once after emitting the wave. The waves spread in the air. The waves will get reflected when they face an object on their path. When the reflected waves are received, the receiver stops timing. The difference in time gives the distance of sensor from the object. It gives excellent noncontact range detection with high accuracy and stable readings in

an easy-to-use package. Its operating condition is not affected by sunlight or black body material. The supply voltage to the sensor is 5VDC. Ultrasonic sensor is available with UART interface. It works at high output acoustic power. Ultrasonic UART distance measurement may come in TTL format from which the user can easily get the obstacle distance.

BUZZER

A buzzer which is also called as a beeper is used to give an audio signal. The buzzer circuit is a mechanical, electromechanical, or piezoelectric. The buzzers or beepers are used to give alarm whenever necessary. These devices also work as timers.

Buzzer consists of an electronic transducers and DC power supply. Therefore, buzzer is an electronic integrated circuit. Active buzzer 5V rated power can be directly connected to a continuous sound. The buzzer and a dedicated sensor expansion module in the board can complete a simple circuit design, to "plug and play."

RADIO FREQUENCY TRANSMITTER AND RECEIVER

Radio Frequency (RF) transmitter section (HT12E) is able to transmit a high frequency radio signal. It is modulated by the input signal and carries data.The radio frequency receiver section (HT12D) collects the modulated transmitted radio frequency signal. Then the receiver section demodulates the signal. This wireless communication is done through RF communication.

The radio frequency transmitter section is mounted on a small printed circuit board. This assembly transmits a high frequency radio signal carrying the data. Transmitter sections are connected with a microcontroller. The microcontroller supplies data to the transmitter sections. RF transmitters intimate the maximum allowable transmitter power output, harmonics and band requirements.

The radio frequency receiver receives the transmitted modulated radio frequency signal. Then it demodulates the signal to extract information. The radio receivers are divided into two types. They are super regenerative receivers and super heterodyne receivers. Super regenerative receivers are inexpensive and are of low power designs. Super regenerative receivers are constructed with a set of RF amplifiers connected in series. They demodulate the received signal. They separate the data from the carrier. The frequency of operation varies with the change in temperature and supply voltage. So, they are considered as imprecise. But, super heterodyne receivers provide better stability in the frequency of operation and accuracy over a wide range of supply voltage and temperature.

V. RESULT AND DISCUSSION

The blind walking stick has been finally made into a prototype which can be used to guide the blind person. The steps in the circuit manufacturing

are PCB fabrication, soldering components, programming, circuit testing and debugging. The circuit uses an ultrasonic sensor to detect the front obstacles and the obstacles underneath. In existing system, the walking stick is only used for obstacle detection. This drawback is nullified in the proposed system.

GSM sends the message in the way of SMS so that it instructs the person using the stick system. SMS will be given from a specific mobile number. The advantages of the proposed system are less cost and easy implementation. Figure 4 shows the entire cane system.

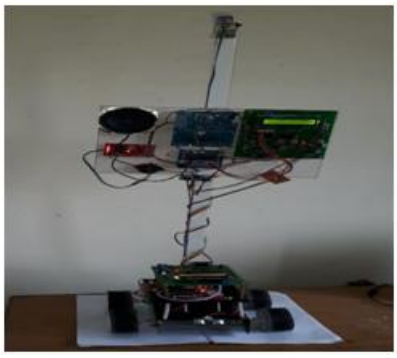

Figure 4. cane system

VI. CONCLUSION

The design and the architecture of a white cane stick system for blind persons is proposed in this paper. The advantage of the system is very low cost. The proposed system acts as an application oriented system to monitor the user where the user is. The system also provides dual feedback making navigation more safe and secure. The main purpose of this study is to produce a prototype that can detect objects or obstacles in front of the user and feeds warning back, in the form of voice messages and sound vibrations, to user. The ultrasonic sensor along with microcontroller works for detection. This project facilitates the movement for blind person and safety.

VII. FUTURE SCOPE

The future includes wearable equipment to have a head hat and mini hand stick. The system is expected to help the blind persons to navigate safely and to avoid a fall due to any object that may be encountered, whether fixed or mobile and to prevent accidents.

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