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INTELLIGENT STICK FOR VISUALLY CHALLENGED PEOPLE

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Abstract— It is well known that people suffering from visual impairments face many difficulties in travelling independently. Due to this, they rely on some form of external aids, which include a variety of tools and techniques like a stick. Such tools are called Electronic Travel Aids (ETA). Sometimes even with the use of this stick, the safety of the blind person is not guaranteed. The stick may not always detect all the obstacles in the path. . The objective of this project is to build a blind man stick that can detect obstacles, potholes and thus help the blind person travel independently. The system is constructed using ultrasonic sensors, a Programmable Interrupt Controller (PIC 16F877A) that has an On-chip Analog-to-Digital Converter (ADC), a vibrator, buzzer and a power supply. The software used in this system includes Embedded 'C', Pickit 2 Programmer, MPLAB..

Keywords — Electronic Travel Aid (ETA); Obstacle Detection; PIC 16F877A; Ultrasonic Sensor; Accelerometer Sensor; Embedded 'C'.

I. INTRODUCTION

Visually impaired people require an efficient method to move around independently. Recently, many techniques have been developed to help the blind move freely in a dynamic environment as well. These tools are called ETA and rely largely on signal processing and sensor technology. ETAs mainly have 2 types of input systems, namely, the sonar input system and the camera input system. All existing systems inform the blind about the presence of an object in front of them if it is too close to them. This allows them to change their direction. However additional information about the shape, width etc of the object will allow them to avoid these obstacles more efficiently. Hence, we have proposed a simple design that will help the blind move without any human support, outdoors as well as indoors and is very suitable for real time applications.

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II. REVIEW OF LITERATURE

We will look into the working of the system and the components used in detail in the following sub-sections.

1) Working and block diagram

Blind stick is an innovative stick designed for visually disabled people for improved navigation.

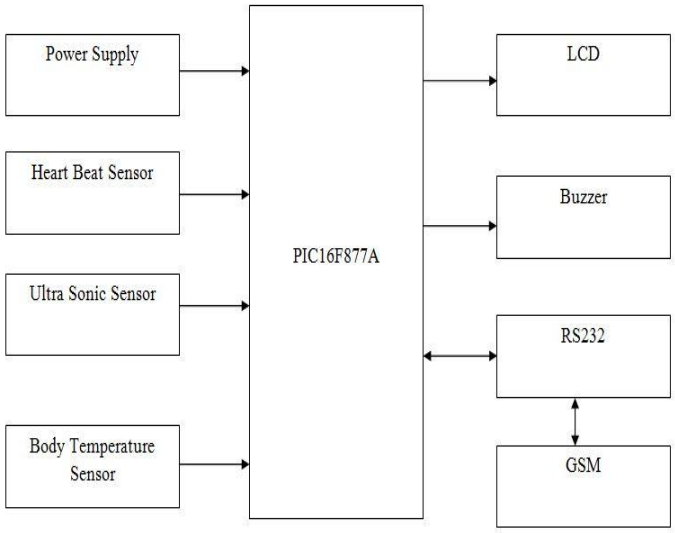

Fig 2.1 Block Diagram

We here propose an advanced blind stick that allows visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with light and water sensing. Our proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates if the obstacle is close enough. If the obstacle is not that close the circuit does nothing. If the obstacle is close the microcontroller sends a signal to sound a buzzer. It also detects and sounds a different buzzer if it detects water and alerts the blind. One more feature is that it allows the blind to detect if there is light or darkness in the room. The system has one more

advanced feature integrated to help the blind find their stick if they forget where they kept it. A wireless RF based remote is used for this purpose. Pressing the remote button sounds a buzzer on the stick which helps the blind person to find their stick. Thus this system allows for obstacle detection as well as finding stick if misplaced by visually disabled people.

The Stick has one more advanced future to intimate or alert the relations and the doctor through the GSM at emergency time in case heart beat, body temperature is abnormal.

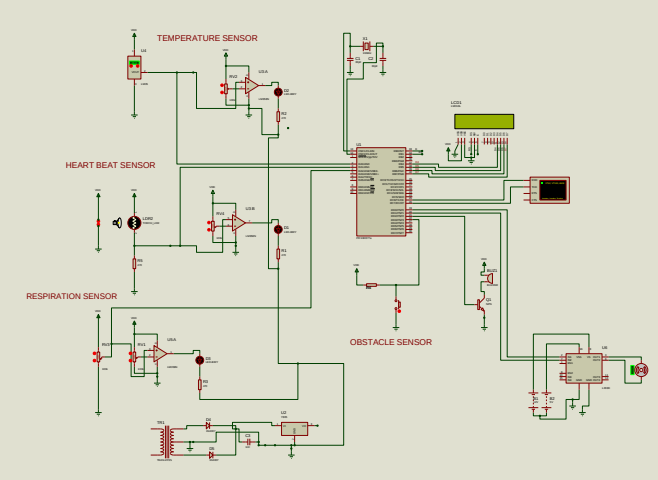

Fig.2.2 Schematic Diagram

A. Hardware Specifications

- PIC16F877A Microcontroller
- Ultrasonic sensor
- Heart beat Sensor
- Body Temperature Sensor
- GSM
- Light Sensor
- Buzzer
- RF Rx-Tx
- Diodes
- Capacitors
- Resistors
- Voltage Regulator
- Crystal
- Led's

B. Software Specifications

- CCS Compiler
- MP LAB
- MC Programming Language: Embedded C

1) PIC16F877A Microcontroller

The system is equipped with an advanced microcontroller to increase the response speed and to decrease computational complexity. PIC 16F877A is used detect any switch triggered. Audio sounds and vibrations are generated by this PIC. The program stored in the memory of the PIC is executed when this microcontroller is switched on. [1] A set of instructions are stored on a single integrated circuit. The PIC is a small computer that comprises a processor core, memory, and programmable input/output peripherals. A Micro C programming code is installed on the PIC, which is an important part of the proposed system.

PIC 16F877A has an On-chip ADC, thus the conversion of the analog signals received by the sensors to digital signals is done by the microcontroller itself. The digital signal obtained is used for calculating the distance of obstacle in the path of the blind person. This system is advantageous compared to the other systems that use a separate microcontroller, ADC, memory, I/O devices and other features like low cost and small size. A +5V power supply is used to operate the PIC. If the input voltage to the PIC exceeds +5V, it can be maintained at +5V using a voltage regulator (L7805). The program is executed using a crystal oscillator without which the PIC cannot run. A high frequency oscillator is used as the PIC is a real-time processing element.

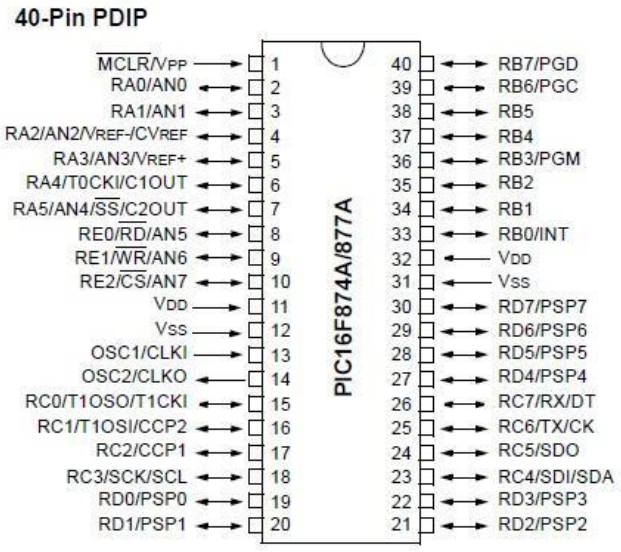

Fig: 2.3 Pin diagram of PIC 16F877A

The PIC16F877A is an 8-bit micro controller having 40 pins, out of which 2 pins are used for Vcc, 2 pins for round,2 pins for crystal oscillator, 1 pin for reset and all other pins are used as I/O pins. This micro controller has 5 ports, as shown in Fig. 2.3. It's main features are as

follows, 256 bytes of EEPROM data memory, 8 channels of 10- bit Analog-to-Digital (A/D) converter, an ICD, 2 Comparators, self-programming, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2- wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART).

2) Ultrasonic Sensor

Ultrasonic sensor is used to measure the distance of the object it is attached to from the obstacle. Now to detect potholes this sensor can measure the distance between the stick and the ground and anytime the distance increases it will be because the ground is uneven or a pothole is present. Therefore, potholes can be detected.

The 28015 ultrasonic also known as The PING sensor is a 3 pin sensor that can detect obstacles in the range of 2cm- 400cm (4 meters). It is very easy to connect to the microcontroller using only 1 I/O pin.

Features

- Supply Voltage – 5 V (DC)
- Supply Current – 30 mA typ; 35 mA max
- Range – 2 cm to 4 m
- Input Trigger – positive TTL pulse, 2 uS min, 5 µs typ.
- Echo Pulse – positive TTL pulse, 115 uS to 18.5 ms
- Echo Hold-off – 750 µs from fall of Trigger pulse
- Burst Frequency – 40 kHz for 200 µs
- Burst Indicator LED shows sensor activity
- Size – 22 mm H x 46 mm W x 16 mm D (0.84 in x 1.8 in x 0.6 in)

Pin Definitions:

1) VCC- 5V (DC)
2) GND
3) SIG- Signal I/O

Fig 2.4 ultrasonic Sensor

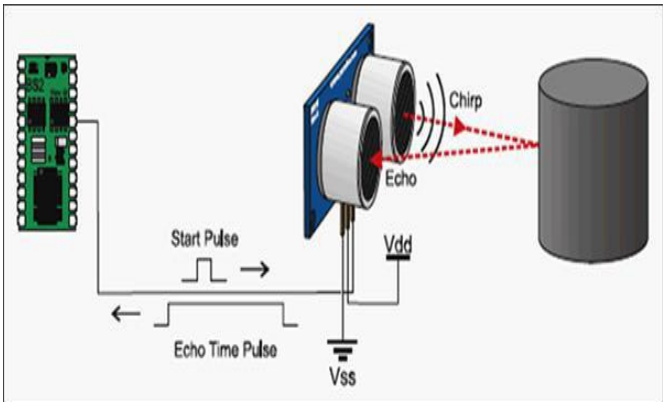

Fig 2.5 Pin diagram and working of an ultrasonic Sensor

The sensor emits sound waves in the ultrasonic range by converting electrical signals to sound signals. If no obstacles are present, these waves pass without reflection. However, in case of an obstacle being present, the waves undergo reflection from the obstacle and return to the sensor. The sensor provides an output signal whose duration is equal to the time required by the echo signal to return. Hence, by measuring the width of the output pulse, the distance of the obstacle can be calculated.

3) Temperature Sensor -LM35

The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin as the user is not required to subtract a large constant voltage from its output to obtain convert centigrade scaling.

The LM35 does not require any external calibration or trimming to provide typical accuracy's of ±1/4 ºc at room temperature and ±3/4 ºc over a full -55 to +150 ºc temperature range. Trimming and calibration at the wafer level assure low cost. The Lm35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with pulse and minus supplies. As it draws only 60microamp from its supply, it has very low self-heating, less than 0.1c in still air. The LM35 is rated to operate over a-55 to 150-ºc-temperature range while the LM35cis rated for a -40 to +110 ºc (-10 with improved accuracy).

The LM35 series is available packaged in hermetic TO-46 transistor packages. While the LM35c, LM35CA and LM35D are also available in the plastic TO-92 transistor package. The LM35Dis also available in an 8-

lead surface mount small outline package and a plastic TO-220 package.

Features

- Calibrated directly in ºc Celsius(centigrade)
- linear +10.0mV/ºc scale factor
- 0.5 c accuracy graranteeable (at+25c)
- rated for full -55 to +150 ºc range
- Suitable for remote applications
- Low cost due to wafer level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain]
- Low self-heating, 0.08ºc in still air
- Nonlinearly only ± 1/4ºc typical
- Low impedance output 0.1Ω for 1mA load

4) Heartbeat Sensor

To build a heart-beat transducer not as difficult as imagined. Circuit below shows a simple heart-beat transducer. This circuit made from an infrared phototransistor and infrared LED. This transducer works with the principle of light reflection, in this case the light is infrared. The skin is used as a reflective surface for infrared light. The density of blood in the skin will affect on the IR reflectivity. The pumping action of heart causes the blood density rises and falls. So that we can calculate the heart rate based on the rise and fall of intensity of infrared that reflected by skin.

5) GSM modem:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer.

Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low -- only about six to ten SMS messages per minute.

Fig 2.6: GSM Modem

6) SMS

SMS stands for Short Message Service. It is a technology that enables the sending and receiving of messages between mobile phones. SMS first appeared in Europe in 1992. It was included in the GSM (Global System for Mobile Communications) standards right at the beginning. Later it was ported to wireless technologies like CDMA and TDMA. The GSM and SMS standards were originally developed by ETSI. ETSI is the abbreviation for European Telecommunications Standards Institute. Now the 3GPP(Third Generation Partnership Project) is responsible for the development and maintenance of the GSM and SMS standards.

As suggested by the name "Short Message Service", the data that can be held by an SMS message is very limited. One SMS message can contain at most 140 bytes (1120 bits) of data, so one SMS message can contain up to:

- 160 characters if 7-bit character encoding is used. (7-bit character encoding is suitable for encoding Latin characters like English alphabets.)
- 70 characters if 16-bit Unicode UCS2 character encoding is used. (SMS text messages containing non-

Latin characters like Chinese characters should use 16-bit character encoding.)

SMS text messaging supports languages internationally. It works fine with all languages supported by Unicode, including Arabic, Chinese, Japanese and Korean.

Besides text, SMS messages can also carry binary data. It is possible to send ringtones, pictures, operator logos, wallpapers, animations, business cards (e.g. VCards) and WAP configurations to a mobile phone with SMS messages.

One major advantage of SMS is that it is supported by 100% GSM mobile phones. Almost all subscription plans provided by wireless carriers include inexpensive SMS messaging service. Unlike SMS, mobile technologies such as WAP and mobile Java are not supported on many old mobile phone models.

7) EMS (Enhanced Messaging Service)

Besides the data size limitation, SMS has another major drawback -- an SMS message cannot include rich-media content such as pictures, animations and melodies. EMS (Enhanced Messaging Service) was developed in response to this. It is an application-level extension of SMS. An EMS message can include pictures, animations and melodies. Also, the formatting of the text inside an EMS message is changeable. For example, the message sender can specify whether the text in an EMS message should be displayed in bold or italic, with a large font or a small font.

The drawback of EMS is that it is less widely supported than SMS on wireless devices. Also, many EMS-enabled wireless devices only support a subset of the features defined in the EMS specification. A certain EMS feature may be supported on one wireless device but not on the other.

III. CONCLUSION

In this paper we have discussed the problems a blind person faces and tried improving on them by designing an efficient system that allows them to move around independently. This system is capable of detecting potholes as well. We use three ultrasonic sensors to detect the distance of the person from the object, a PIC with and an on-chip ADC and an accelerometer sensor. The sensors have been utilised fully to ensure safe and secure mobility of the visually impaired people. Since three sensors are used, objects can be detected in front of the person as well as on either side. This system is easy to use and does not require any sort of training. Also it addresses some of the problems faced by the blind people that are not taken into account by other ETAs. It is not very expensive and easy to carry around.

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