GPS Talking For Blind People

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***Abstract*—In this paper, we design device to help the blind people to navigate the environment without asking anyone. The device based on GPS (Global Positioning System), the raw data for location coordinate where the blind people stands is detect by GPS receiver, processing these data by PIC microcontroller to calculate real coordinate related with current position, then translate it to specific voice message which are presorted in voice recorder, the blind person hears voice message through the headset. Our design aims are to produce device that is more cheap by using little number of components and easy to use so that the blind person not need to do any thing just hearing the voice message. The device be practically tested by some blind people who are members of Abdallah Bin Maktoom blinds school in Jordan, they gives good opinion about device.**

***Index Terms*—GPS receiver applications, navigate system, microcontroller applications, digital system design.**

I. INTRODUCTION

Imagine being blind and trying to find your way around a city you've never visited before -- that can be challenging for a sighted person. Researches design navigator system based on new development technology, tools, small and wearable devices to help people who are blind and visually impaired. The WHO (World Health Organization)[1] estimates in 2002 that there are 161 million; about 2.6 % of the world population; visually impaired people in the world, 124 million of them had low vision and 37 million are blind. These visual impairment people are distributed fair around the world as shown the Fig. 1. For that we try in this research to build a useful device to help the blind people to navigate through the city and receive in each step a voice massage tell them where he is now.

Blind people can obtain information from the unwilling contact with objects, persons or animals, by exploring the environment and using their hands to understand the shape of an object, more over, blind people can perceive other features of the objects as temperature, texture, weight… and though the tact has certain limits in confront of sight, it has a very important function in reveal to blind persons the world around them. Another sense is very important in the life of blind people: the heard, that has great qualities of global, longer range discernment, and on which they rely upon for identification of objects and spaces.

Many researchers and companies are developing technologies and device that emits sound to help blind peoples to navigate the world.

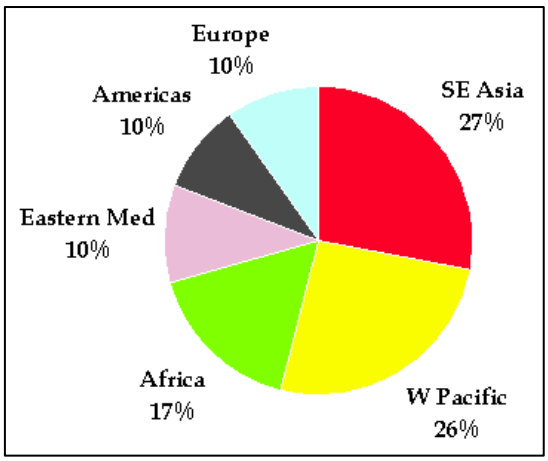

Figure 1: Global estimation of visual impairment by WHO region

The SWAN system [2] consists of a small laptop worn in a backpack, a proprietary tracking chip, Global Positioning System (GPS) sensors, a digital compass, a head tracker, four cameras, a light sensor, and special headphones. The sensors and tracking chip send data to the SWAN applications on the laptop, which computes the blind's location and in what direction he is looking. It then maps the travel route, and sends 3D audio cues to the bone phones to guide the traveler along a path to the destination. Researches at Wright State University [3] design a portable system; called Tyflos -- Greek for blind -- consists of a tiny camera mounted on a pair of glasses, a laptop carried in a backpack, a headset and a microphone. Tyflos converts the images to sound. Computer algorithms process the images and extract information from them to give the blind information about what they are looking. Scientists at the European Commission's Joint Research Centre [4] have developed a prototype system, SESAMONET (Secure and Safe Mobility Network), which uses RFID micro-chips embedded in the ground to guide a visually impaired person through a predefined area. The microchips can be recycled from the electronic tracking of cattle. Each micro-chip sends position signals via a dedicated walking stick to a smart phone containing information about the location and a recorded voice – via a Bluetooth headset - guides the visually impaired person along the route.

doi:10.4304/jetwi.2.3.239-243

The main objective of our project is to design a small and simple navigate device to help the blind people to get environmental information as voice message depend on GPS technology. GPS system is used wide in both civilian and military applications. GPS system offers various aids for the autonomous mobility of visually impaired persons:

1). Provides information about turns and obstacles on the path.
2). Checks the right direction (useful if user falls or is disoriented).
3). Provides general and specific environmental information.

II. DESIGN OF THE BLIND DEVICE

The block diagram for our designing of blind navigation device is shown in Fig. 2, which is consist of GPS receiver, PIC microcontroller, Voice recorder, LCD, Headset and other supplementary components.

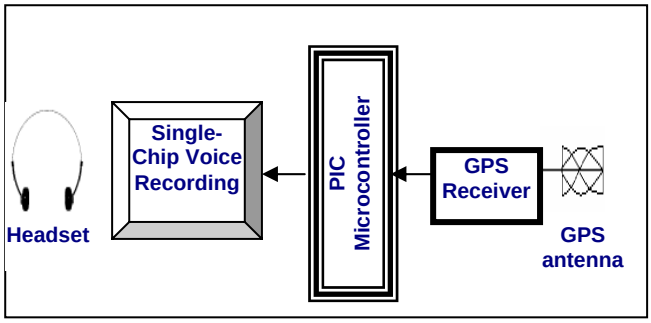

Figure 2: Block Diagram for Blind Device.

In this part we describe the features of all components consist in the designing system and explain how these components are connecting together, as shown in Fig. 3, to accomplishment the blind device concepts.

A. GPS Receiver

GPS is a satellite-based global navigation system [5, 6] that enables users to accurately determine 3-dimensional positions (x, y, z) worldwide.
GPS consists of 3 segments. They are:

1). The space segment consists of at least 24 satellites. The satellites circle the Earth once every 12 hours. The satellites transmit radio signals continuously to broadcast its changing position and time.
2). The control segment consists of ground stations that monitor and control the satellites.
3). The user segment consists of the user and the GPS receiver. The GPS receiver measures the signals from the satellites and identifies the user's position.

The satellites are spaced so that from any point on Earth, at least four satellites will be above the horizon. Each satellite continually transmits radio signals and broadcasts its position and time. GPS uses satellites in space as reference points to locate the positions on the Earth. The GPS receiver measures our distance from the satellites by measuring the travel time of the radio signals. The distance from the satellite to the GPS receiver is equal to the travel time from the satellite to GPS receiver multiplied by the speed of light. That is, Distance = Travel time x Speed of light. 0On the ground, any GPS receiver that contains a computer can locate its own position on the Earth by measuring accurately the distance from three satellites. The result is provided in the form of a geographic position – longitude and latitude.

We use Rockwell TU00-D200-401 as GPS receiver is single-board, high performance, low power, and 12-channel receiver. It is Dimension 50.98 x 71.12 x 10.2 mm, a +5V primary DC input power supply, a GPS antenna and a TTL to RS232 level to be converter able to communicate with serial port.

B. Voice Recorder

For voice information we use single chip voice recorder (APR9600), it is high quality voice recording with non volatile storage and a play back ability for 40 to 60 seconds with minimum external components so no external IC required, and it is easy to use so there is no need to program or develop it. The APR9600 device is able to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

The device supports five message management modes Therefore, the designer must select the appropriate operating mode before beginning the design, and these modes are:

1). Random Access 2 fixed duration messages
2). Random Access 4 fixed duration messages
3). Random Access 8 fixed duration messages
4). Tape mode, Auto rewind operation
5). Tape mode, Normal operation

In our project we use Random Access 8 fixed duration messages mode, because Random Access mode provides easy indexing to massage segments and the recording or play back can be made randomly in any of the selected messages.

C. PIC Microcontroller 16F877

We used low cost 40 pin PIC Microcontroller 16F877, as controller part to the system, as shown in Fig. 3, for correct work, it needs:

1). Power supply: in range between 2-6 volts, we used a +5V as a power supply with the VDD, but the VSS we connected it with the ground.
2). Voltage stabilizer: to stable source voltage, so we used a voltage stabilizer which gives stable +5V on its output.
3). Reset: to return the device into a particular state. We connected the pin1 (MCLR) with 10k resistor.

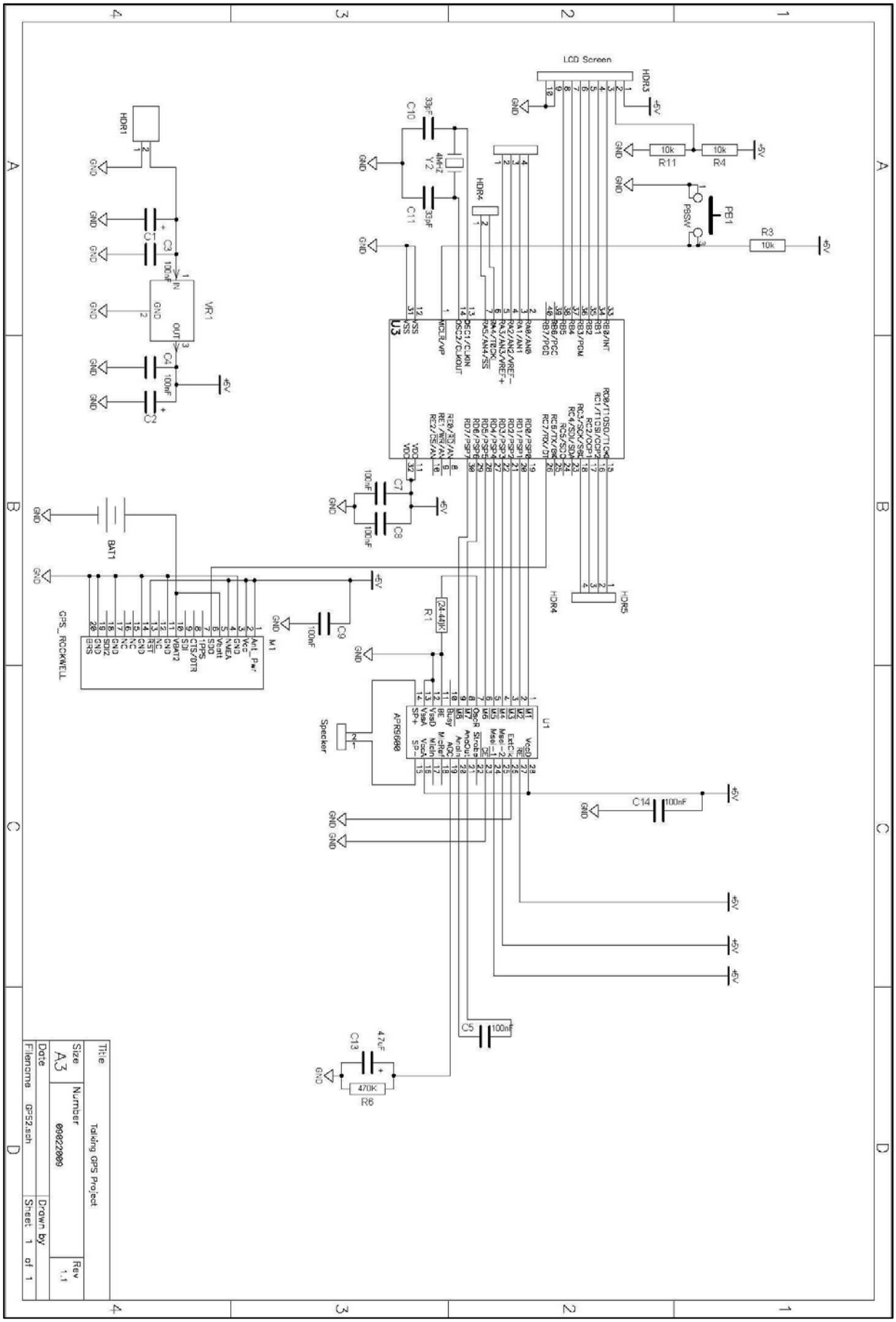

Figure 3: Connection of all device components

4). Oscillators: use 4MHz crystal oscillator to generate the device clock, connect pin 13 and 14 (OSC1 and OSC2) with two capacitors 33pf.

The microcontroller converts the current position coordinates; which be compute by GPS receiver; to address the specific voice message stored before in voice recorder chip related with the current position.

The functionality of microcontroller, as shown in Fig.4, is to receive GPS Fix Data (GPGGA) for a GPS receiver, which content the time, position and other fix related data, for detail of GPGGA format see reference [7], and from GPGGA message, the microcontroller extract the Latitude and Longitudinal components of position. Then the microcontroller sends this position information to both units, LCD to display it and to voice recorder chip to address and play the voice message related with current position.

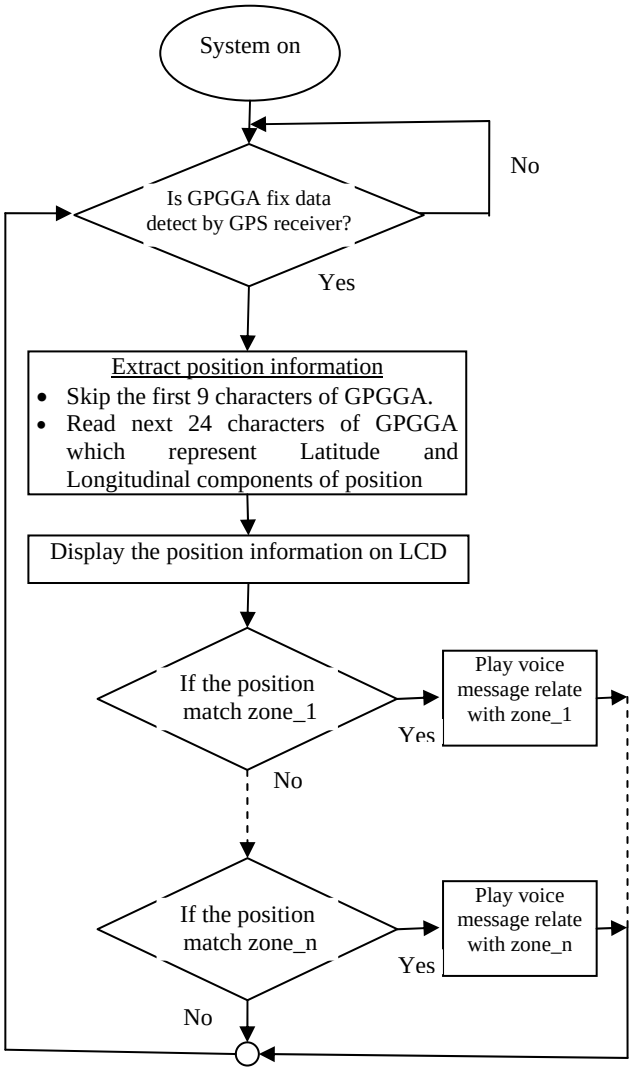

Figure 4: microcontroller function algorithm

D. Microphone and Headset

During learning and updating step of the system, the designer use microphone to store voice message into voice recorder chip. Also during running step of the system, when the blind people navigate the places, the headset is necessary for them to hear the voice message related with current position.

E. LCD Device

The LCD device is used by the designer in learning step and updating of the system, through LCD, the designer can read the current position coordinates that being calculate by microcontroller.

III. System Test and Implementation

The device is tested in faculty of Computer Engineering Technology - Al Balqa Applied University camp. During learning phase we navigate the camp and determine the latitude and longitudinal components of position for boundary are of 8 building prototype, each building known as zone and define it by two diagonal points, see table (1).

In each zone the position coordinates for it points are displayed on LCD screen, when the GPS receiver capture GPGGA messages at these points and then the microcontroller process it to extract latitude and longitudinal components. Also the microcontroller convert these latitude and longitudinal components for zone's points to specify address on voice recorder chip in which the designer store voice message tell what is the building in that zone.

During running phase we contact with Abdallah Bin Maktoom blinds school to test the device practically, the device be use by blind people and we get good opinion. "the device is very simple and it be more useful if it cover the whole Jordan, so it is easy form to navigate across Jordan without asking any body where I am", said Mr. Mohammad Dyab Khaid who lost sight, and he work as science teacher in the school. "I change my home and really I faced a big problem because I haven't any idea about places near my new home, but may be with my new friend, GPS Talking device, I can easily tour any where", said Mr. Mansoor Martooq, who is Arabic teacher in the same school.

IV. Conclusions

In this project we design a small device, very easy to use called, GPS Talking Blind People, help blind people to navigate around camps, cities and get voice messages tell him where he is now?

The device loaded with prototype information about some building in faculty of engineering technology camps and test successively by blind people.

Table 1: Position Coordinates for 8 prototype zones.

Locations	First point	End point
Building number 17	3159.604 N-3601.114 E	3159.647 N-3601.129 E
Building number 5	3159.601 N-3601.093 E	3159.583 N-3601.135 E
Building number 9	3159.787 N-3600.968 E	3159.539 N-3601.116 E
Book shop	3159.557 N-3601.055 E	3159.567 N-3601.134 E
IEEE student branch	3159.567 N-3601.134 E	3159.511 N-3601.119 E
Engineering Workshops	3159.616 N-3601.087 E	3159.428 N-3600.903 E
Library & Registration	3159.560 N-3600.996 E	3159.571 N-3601.009 E
Student society & Cafeteria	3159.428 N-3600.903 E	3159.557 N-3601.055 E

During designing of the device we face some problems such as:

1). Same times the position coordinates is not stable at the same point because the GPS system is not very accurate, it has a range of error about 2-3 meters, delay of GPS signals when pass atmosphere, also the accuracy effect on number of satellites be detect by GPS receiver.

2). GPS system can't use it indoor building or closed area, so we test the device outdoor only, for indoor we must use some additional equipments.

3). The storage capacity of APR9600 voice recorder is relative small, play back ability for only 40 to 60 seconds. So for extending and updating the device it must it with more storage capacity chips.

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