Microcontroller Technology for Navigation Assistance Technology

Navigation assistance technology for the visually impaired has taken different forms such as walking sticks, and sensor based glasses and headgears for object detection. Such sensor based technologies require microcontrollers to interface between different sensor inputs and outputs to the user. This paper reviews microcontroller technologies used commonly to interact with other peripheral devices along with details on microcontrollers used in the past for developing navigation assistance technologies. The paper specifically reviews two such microcontrollers, exploring various features and uses.

Commercial Application of Microcontroller Technology:

Microcontroller technology is used in every embedded device ranging from automated toothbrush to communication satellites and autonomous vehicles [1]. An application of microcontroller is the automatic car parking indicator system which can be used in parking lots to indicate available parking spots to the driver [2]. Such a system was developed by Microtronics Technologies and costs $80.77 per unit. The device uses IR sensors, AVR microcontrollers, and LED display component.

Some products have been developed to assist visually impaired people with navigation. Haptic Assisted Location of Obstacles (HALO) is a device developed by Steve Strubing and uses vibrations as the output, informing the user about the presence of an obstacle in his/her path [3]. This device uses an Arduino MEGA 2560 microcontroller. This product is still in the development stage. Another similar project is an object detection and guidance system for the visually impaired by Al-Shehabi et al. [4]. They use a Microsoft Kinect Sensor, a tablet PC and an ATMEL XMEGA A1 microcontroller to develop a headgear for the visually impaired. The use of Kinect causes portability issues.

Microcontrollers are used as part of an embedded system and comparing prices of different embedded systems would not be valuable. Instead, a comparison of two different commercially available state of the art microcontrollers is presented here: Arduino MEGA 2560 and NXP LPC 1768, costing $44.95 and $49 respectively [5-6]. These devices have varying memory, I/O pins, power consumption and other features which would be further explored and compared in the following sections.

Features and Components of Microcontrollers:

Microcontrollers are the processing unit for embedded systems, connecting different input and output devices, and providing memory storage. Arduino MEGA 2560 microcontroller has 54 digital I/O pins, 16 analog I/O pins, four UARTS, and a USB connection [7]. This provides freedom in connecting different types of external devices such as sensors without adding extra I/O pins. It can be powered using a

computer, AC-DC power supply or a battery, thereby increasing the flexibility of design. The microcontroller also provides a flash memory of 256 KB. The Arduino Software IDE can be used for programming this microcontroller and it comes with a bootloader that avoids the need of an external hardware programmer. The microcontroller has a clock speed of 16MHz. Power consumption is 20mA per I/O pin.

Another state of the art microcontroller is mbed NXP LPC1768 mentioned earlier [8]. This device uses the ARM core processor and has a clock speed of 96MHz. This allows for better performance than the Arduino processor, especially in terms of speed and power consumption. Memory available is 512 KB and power consumption is 60mA – 120mA. It allows for USB power supply using a computer or external power sources such as AC-DC power supply or battery. It has six analog I/Opins, six PWM output pins, three UARTS, two SPI, and two I2C interfaces. No software installation is needed as a free online mbed compiler is available for programming using C++.

Implementation of Technology:

A relevant aspect of using any microcontroller is how it would communicate with other peripheral devices like sensors, or computers. The availability of software libraries for both the microcontrollers mentioned above make them efficient for development of new embedded systems. Mbed provides various APIs that can be used to develop new applications without performing low level coding. Communication with peripherals such as I2C and serial ports can be done using APIs designed for such communication. Similarly, Arduino also provides firmware source code in the Arduino repository and this can be utilized to communicate with various peripherals. SoftwareSerial Library allows for serial communication for digital pins.

Conclusion:

With different trade-offs present in the two microcontrollers presented here, mbed NXP LPC1768 is more advanced in terms of performance, speed, and power consumption. Arduino would not be the best choice for a battery run device with multiple peripheral devices attached because each I/O pin consumes 20mA of power. Power consumption for a battery run device is important feature to be considered. Some other microcontrollers that are not used commonly are also available but lack resources for development.

References:

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