

Iot Sensors and Mobile Applications for Life Style Management of Visually Challenged Persons

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Abstract: Many research are undergoing in the area of IoT based applications for visually challenged persons. Study says that approximately 8 % of USA people are partially or fully visually blind. But unfortunately many people are not aware of how our technology really supporting them to overcome or lead a normal in spite of their disabilities. In this chapter I would like to review and analyse someof the useful mobile applications which they can use in their daily life with the technologies using in daily life like mobile phones so that they can do normal life without seeking others help. Apps like text recognitions enable them to make phone calls, receive phone calls, set and reset screen lock, alarm to find the place of mobile etc. Definitely these apps will help them to lead a normal life like others without disturbing others or others interventions. Many sensors are also now-days available to help visually impaired persons. Also technologies like Quantum level light sensors can replace damaged retinas. An introduction and usage of those products also will help them to motivate in future life.

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I. Introduction

The World Health Organization (WHO) reported that there are 285 million visually-impaired people worldwide. Among these individuals, there are 39 million who are totally blind. There have been several systems designed to support visually-impaired people and to improve the quality of their lives. Over the past years, blindness that is caused by diseases has decreased due to the success of public health actions. However, the number of blind people that are over 60 years old is increasing by 2 million per decade. Unfortunately, all these numbers are estimated to be doubled by 2020. There are various assistive devices are available for the visually impaired persons. Now the technology Internet of Things (IoT) is rapidly growing in all aspects of the real life problems, many sensor based devices are available for the blind person. And because of the technological advancement, many of the devices can be directly connected to a computer and data can be analysed. This chapter focuses such many IoT devices and mobile apps currently available for visually impaired persons. Many barriers of visually impaired persons such as in education and employment are completely removed by the new technological improvement especially in the IT sector. Students with visual impairments can complete homework, do research, take tests, and read books along with their sighted classmates, thanks to advances in technology. Adults with visual impairments can continue to work and pursue a tremendous range of careers because of the use of computers and other devices. Assistive technology also enables people with visual impairments to be more independent at home or at work. They can read the emails; listen to music can read eBooks, get step-by-step walking directions to unfamiliar places. There are also devices like talking watches, thermometers, scales, blood glucose and blood pressure monitors that help them to live independent and healthy lives.

Mobile Apps

First we will go through some mobile apps which are available in the market. As technological advancement happens day by day and more research is also happening in computer science fields, professional are started developing many software applications specifically useful for visually impaired persons. These apps will help them in their daily life without seeking others help.

LookTel: The Money Reader App

LookTel Money Reader instantly recognizes currency and speaks the denomination, which will help visually impaired people to know the denomination of the currency and pay the bills accordingly. Point the camera of your iOS device at a note and the application will tell you the denomination in real-time. Currently the app recognize twenty-one currencies that are , the US Dollar, Australian Dollar, Bahraini Dinar, Brazilian Real, Belarusian Ruble, British Pound, Canadian Dollar, Euro, Hungarian Forint, Israeli Shekel, Indian Rupee,

Japanese Yen, Kuwaiti Dinar, Mexican Peso, New Zealand Dollar, Polish Zloty, Russian Ruble, Saudi Arabian Riyal, Singapore Dollar, and United Arab Emirates Dirham.

In LookTel app the recognition happens instantly in real-time so the person gets result immediately. Since the app does not require any internet connection for the detection purpose, it can be used anywhere and at any time. It can be used to quickly and easily sort money with independence and confidence. The denomination is also displayed on the iOS devices in high contrast large numerals, for those having sufficient vision to make use of the display. LookTel Money Reader provides Voice Over support for several languages including English, Spanish, French, Italian, German, Polish, Portuguese, Russian, Korean, Finnish, Danish, Swedish, Norwegian, Japanese, Greek, Hungarian, and Mandarin.

KNFB Reader App

The KNFB Reader converts printed text into high quality speech to provide accurate, fast, and efficient access to both single and multiple page documents with the tap of a button on the iPhone. It features the best OCR (optical character recognition) technology available and uses patented image detection technology to quickly and easily detect and decipher printed text anywhere, anytime. Now available for iOS, Android, and Windows 10 devices. It helps blind, low-vision, dyslexic, and other print-disabled users live the lives they want, independently. KNFB Reader is as easy as one-two-three.

1. Use the built-in image alignment to set up the perfect image of any text quickly and easily.
2. Take a photo.
3. Hear the text read aloud or turned into Braille.

KNFB Reader reads receipts. You will know what has been put on your credit card at restaurants, stores, or in taxis.

KNFB Reader reads packaging labels, mail, and product or nutritional information instantly and can read print on your computer or tablet screen when your screen reader is not cooperating. Photograph the screen and know exactly what the screen says. KNFB Reader captures longer documents such as books or product manuals. Use batch mode to scan multiple pages at a time. Turn the pages as you shoot the photos. Text can be exported to Dropbox or Google Drive for use any time. KNFB Reader allows you access to your most private documents with complete independence. Review your taxes. Check the terms of your lease or mortgage documents. Read your lab reports from the doctor. Read your bills – even those with tables. The app is fully accessible thanks to Google Talkback and Voiceover app functionalities that guide the blind user in taking the perfect picture. It is also compatible with connected Braille displays.

Tap See: Identify Objects through Photos

TapSee is designed to help the blind and visually impaired identify objects they encounter in their daily lives. Simply double tap the screen to take a photo of anything, at any angle, and hear the app speak the identification back to you. TapSee is a mobile camera application designed specifically for the blind and visually impaired iOS users, powered by the CloudSight.ai image recognition API. The app utilizes the device's camera and Voice over functions to photograph objects and identify them out loud for the user. In TapSee, the user double taps the device's screen to photograph any two or three dimensional object at any angle, and have it accurately analysed and defined within seconds. The device's Voice over then speaks the identification audibly to the user.

TapSee includes the following additional features:

- a) Repetition of the last image's identification
- b) Ability to upload images from the camera roll
- c) Share identification via Twitter, Facebook, text or email, rotor reader, flash toggle
- d) Ability to save the identified image to the camera roll with the attached tag.

In the latest update to this app the developer has added a lock focus sound which means that when you are getting ready to take a picture once the camera has focussed on the item you will hear a short high pitch tone. At this point you should double tap on the Take Picture button to snap a photo of the item. Once you do this you will hear Voice Over say Picture Taken.

WalkyTalky

One of the most common problems that many visually impaired and blind people experience is navigation. Most of the time, they need to be equipped with a walking stick, or accompanied by a guide dog. The app has an exceptional navigation aid that will greatly help people with visual impairment navigate the streets. Users will be able to get instant updates on their current location as the app has a built in compass and will always point to the right direction. If a user gets lost, the app will automatically vibrate and tell the user that he or she is going the wrong way. Periodically updates the status bar with your current location to the nearest street address. Ability to input a destination and directly launch Map navigation in walking directions mode.

ViaOpta Daily

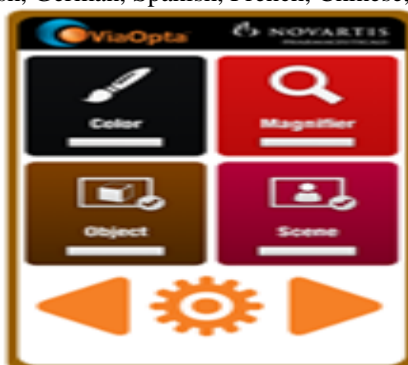
ViaOpta Daily is designed as a personal assistant to help people with low vision with everyday activities. You can use the app to:

- Understand the world around you with greater ease using features such as the voice-guided money, scene, object and colour recognizers.
- Learn what is in front of you with the new scene and object recognizer features.
- Listen to the weather forecast, set a timer, and access your phone's contact list.
- The app also has a built-in magnifying glass for convenience.
- ViaOpta daily is available in twelve languages including English, German, French, Spanish, Arabic, Japanese, Chinese, Greek, Portuguese, Dutch, Italian and Hungarian.
- Requires iOS 7.0 or later. Compatible with iPhone, iPad, and iPod touch. This app is optimized for iPhone 5 and also requires Android 4.0.3 and up

ViaOptaDaily is a multi-tool application that can help blind or visually impaired people in their everyday life. It uses voice guide and every section has an audible tutorial. Users can use it in various contrast modes, or in blind mode alike. It incorporates 6 main functions:

- Weather (current and 3 day's forecast)
- Magnifying glass
- Timer
- Contacts
- Colour recogniser
- Money recogniser (US Dollars and Euros)

It has seven languages built in: English, German, Spanish, French, Chinese, Arabic, Japanese.



Braille EDGE 40 Deaf-Blind Communicator

The Braille EDGE 40, in addition to being a versatile, high-quality Braille display and a basic Notetaker, serves as a face to face communicator with our new iOS communicator application. Braille EDGE can be used as a Braille Terminal by Connecting the Braille EDGE 40 to your PC, MAC, or Smartphone and gain intuitive Braille access using a variety of screen readers across multiple platforms. Use the Braille EDGE 40 to ergonomically and efficiently type text messages, read emails, navigate web pages via your device's web browser and access your appointments.

iOS Connectivity via Bluetooth



Braille EDGE 40 operates as a Braille display via Bluetooth with iOS devices providing Braille keyboard input and Braille output for iPhone or iPad. By using terminal clipboard on the Braille EDGE to comfortably edit text on the EDGE 40 before sending to the I-device as well as to copy and paste text from the Braille EDGE's Notepad application to the iPhone or iPad. Also iOS Deaf-Blind Communicator can easily es-

establish a Bluetooth connection between your Braille EDGE 40 and iPhone and use the combination as a face to face Deaf-Blind Communicator.

iBlind

iBlind is an IOT based android app. One of the major problem a visually impaired persons is that difficulty to search the mobile phone. This app provides a sensor which can be placed in a fixed location and it provides a button to press. When the button is pressed it gives an alarm in the mobile phone about fifteen seconds and thus the person can be notified the location of the phone. The other major features of this app includes

- a) Make a call
- b) Play music
- c) To know the status of phone battery
- d) To know the current location

Using this app a person can make a dial by a long press in the call menu. This provides a call list in favourites, contact list or dial pad. User can select their choice based on their requirement. A voice message is played each time when they make touch. In the play music option they can select songs using next , previous and favourites list and here the music without seeking others help to play the music available in their mobile phones. To know the place of their current location, they need to press the location option. Another important feature of this phone is batter status information. Usually blinds feels difficult to know the current status of battery charge. This is addressed in this app. When they select this option, it tells the battery charge in percentage.

IoT Devices

The life on earth and the sense of the change in surroundings is highly depends on each other. So sensors have become part of our daily life. Recent years witnessed tremendous advances in wirelessly networks and its sensors. Wireless sensor nodes are typically low-cost, low-power, small devices equipped with sensors, data processing and wireless communication capabilities. Day by day , these are becoming smaller, cheaper, while more powerful and more pervasive. Sensors of all types try to mimic certain sense organs of living beings gifted by nature in order to connect with the environment. The sensors can provide the emerging issues that are linked with health care. Sensor technology represents one of the emerging areas of physics, electronics and biotechnologies, and is the one that has most greatly exploited by the innovations in the individual microelectronics, optical and computer sciences technologies. Recently sensors have been considered as a highly potential field of scientific research. However, biosensors also have emerging importance.

Commonly used sensors in Internet of Things (IoT)

The large varieties and sort of sensors accessible in the market at show day. They are utilized for the change of nature of human way of life. The significance of IoT rises step by step, a sensor in its part is planned the estimation of physical outside jolt and records, demonstrates or reacts to it that can be perused by a client or another gadget. The most ordinarily utilized sensors in Internet of things are depicted in the accompanying.

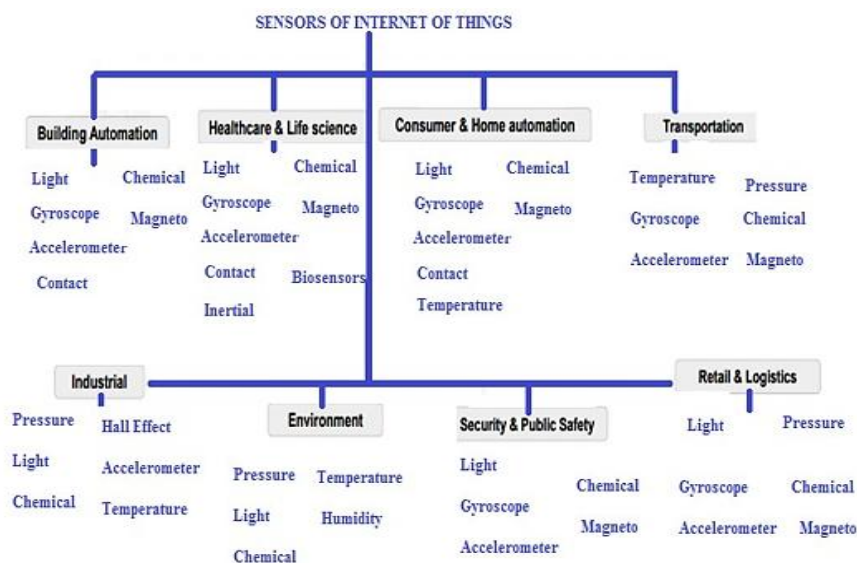


Figure-1 Types of Sensors

Proximity sensors

such as security, safety, or efficiency. They are generally utilizing as, for example, security, wellbeing, or productivity. These sensors are utilized to find out Pets, Insects, Rats or any animal movement in agricultural field so it can utilize effectively in smart agriculture management. Closeness sensors utilizes electromagnetic radiation like radar signs to recognize movement or habitation. Proximity sensors have best use in numerous types industry [10,11]. The retailers utilize closeness sensors to discover region of the clients once they are close to their premises by sending them a few offers on their IoT gadgets. It additionally can be utilized as a part of stopping frameworks, exhibition halls, airplane terminals, and so forth.

Pressure sensors

Pressure sensors are utilized for estimating weight of a gas or fluid. Weight sensors changing over the physical power into an electrical signal. They are additionally can be successfully utilized for estimating different factors like speed and height or comparable circumstance somehow. Indicators and weight checks are the normal utilizing weight sensors utilized for IoT framework. Indicators are useful in climate estimating as it can give exact estimation of encompassing air. Weight checks are for the most part utilized as a part of mechanical destinations as it is useful for the monitoring of weight in shut environments. Pressure sensors are extreme answer for IoT gadgets as it can be utilized for different territories, for example, touch screen gadgets, bio medicinal gadgets, car systems and fabricating industry .Micro weight sensors are kind of little size sensors for the estimation of weight. The principal small scale sensor was produced and utilized by industry piezoresistive pressure sensors.

Optical Sensors

Optic detecting innovation is utilized to distinguish electromagnetic energies like light .It use idea of the photoelectric impact, says that there will be a launch of electrons, when a contrarily charged plate of some proper light-delicate material, is strike by a light emission. The electrons would then be able to be made to stream as a current from the plate nourish as a flag. The greatness of the electric current delivered is specifically corresponding to the light force or number of photons [13,14]. They can transmit, get, and change over light vitality into electrical flag. The fiber optic sensor of IoT interface is associated with web and can collect various data for checking diverse parameters .These optical sensors generally use in various sorts advanced cameras which go about as one of the major physical gadgets of an IoT framework.

Accelerometer and gyroscope

Accelerometer is utilized to distinguish vibration, tilt and straight speeding up. It is utilized for execution of pedometer, levelling, vibration alert, anti-burglary and that's only the tip of the iceberg. It is used for implementation of pedometer, levelling, vibration alert, anti-theft and more. Gyroscope is used to measure angular velocity. Gyroscope is mainly used in 3D mouse, games and athlete training. It has been widely using for detecting any tilt in the position in the field such as Robotics and Industrial automation.[15]. It has been generally utilizing for identifying any tilt of the position in the field. Example is, Robotics and Industrial mechanization. It widely using in Agriculture robotics that supports the smart agriculture management.

IoT Sensors for visually impaired persons

The proliferation of the different types of sensors and IoT devices, Wireless sensor networks opens up unprecedented opportunities for a wide variety of scientific, industrial, agricultural, commercial and military applications, such as health care, smart transportation, emergency response, home automation, social studies, critical infrastructure protection, and target tracking, just to mention a few, which will ultimately improve the quality of life. The next major application includes implantable micro pressure sensors which are used for continuous internal eye pressure monitoring for Glaucoma patients[8]. Glaucoma is the second major cause of blindness in the world after cataracts. A normal eye maintains a pressure in the range of 10-22 mm.Hg which is equivalent to 1.333 kPa to 2.666kPa. Abnormal elevation (Greater than 22 mm.Hg ,equal to 2.666kPa) and fluctuations are the major risk factors for glaucoma. Pressure sensor implemented on a Contact lens to monitor Intraocular Pressure (IOP) of eye. It consists of a disposable contact lens with a pressure sensor element, an embedded loop antenna as shown rings in figure, and a tiny microprocessor. This sensor includes a circular outer ring and a passive strain gauges that could measure corneal curvature changes in response to internal pressure (IOP). This antenna can receive power from the external monitoring system and sends information back to the system. This can connect to a IoT system. Common sensors that improves daily life of visually impaired persons are below.

Figure-Internal Eye Pressure Monitoring Sensor



Figure-Internal Eye Pressure Monitoring Sensor

Guidesense

Guidesense is an assistive device for the visually impaired based on unique technology. VTT Technical Research Centre of Finland has developed this wearable assistive device for the visually impaired, which enables them to sense their environment and move around more safely. The device, which is worn like a heart rate monitor, has been clinically tested. Guidesense enables visually impaired to perceive their environment better and safer. It monitors the obstacles in front of the user and uses vibration and/or voice feedback to convey this information to the user. The device functions on the basis of a radar system developed by VTT.

Guidesense prototype device has been clinically tested by 25 visually impaired test users in device trials approved by the National Supervisory Authority for Welfare and Health. Partners in the trials are VTT Technical Research Centre of Finland, Kuopio University Hospital and the Finnish Federation of the Visually Impaired (FFVI). Guidesense device consists of a flexible belt and a sensor module. The device is worn like a common heart rate monitor belt. It is important that the sensor module is pointing forward in the walking direction. The operation of the Guidesense device is based on high-frequency radar technology developed by VTT Technical Research Centre of Finland Ltd. The radar signal goes through typical clothing materials. This makes it possible to use Guidesense discreetly beneath clothing, for example under a jacket.

The device is primarily meant for outdoor use. Indoors, where there are typically many obstacles nearby, interpreting the vibration and voice feedback is more challenging. The radar conveys information to the user in the form of vibrations or voice feedback. It senses most obstacles in the user's surroundings, although difficulties remain in sensing objects such as thin branches and bushes. A total of 92% of the trial users felt that the device helped them to perceive their surroundings, 80% felt that their trust in their ability to move around independently had increased and 32% would immediately start using the test device in its current form.

SmartCane

SmartCane device is an electronic travel aid which fits on the top fold of the white cane. It serves as an enhancement to white cane and overcomes its limitations by detecting knee above and hanging obstacles. For safe mobility, it is important that such obstacles are detected early. The cane has other uses as a spatial awareness device as it can detect presence/absence of objects in the surroundings. Further, as compared to the white cane, the detection distance is increased from 0.5 meters to 3 meters. It informs about the presence of objects before actually touching the object with the cane and thus helps in preventing unwanted contact. This avoids situations like collision with people, animals or into trash. Smartcane device uses ultrasonic ranging to detect objects in its path and generates tactile output in the form of different vibratory patterns. These vibrations convey the distance information and thus enable the user to negotiate the obstacles from a safe distance. With simple orientation and training, any visually impaired person who is a regular user of the white cane for mobility can benefit from this device. Smartcane ensures independent mobility, safety and gives confidence as it, detects hazardous, raised knee-above obstacles, gives pre-warning of obstacles and allows path finding without collision, Reduces injuries and chance of collision during mobility. Smartcane is easy to use and tested for robust and reliable use. Smartcane ensures independent mobility, safety and gives confidence as it



- Detects hazardous, raised knee-above obstacles
- Gives pre-warning of obstacles and allows path finding without collision
- Reduces injuries and awkwardness of collision during mobility

Smartcane is easy to use as it

- Enhances White cane use
- Has a convenient ergonomic grip
- Is tested for robust and reliable use

Eye Substitution

An embedded device to act as an eye substitution for the vision impaired people (VIP) that helps in directions and navigation as shown in following figure



Mainly, the embedded device is a TI MSP 430G2553 micro-controller. This is an android based application and role of this application is to use GPS, improved GSM, and GPRS to get the location of the person and generate better directions. The ultrasonic sensors send a sequence of ultrasonic pulses. If the obstacle is detected, then the sound will be reflected back to the receiver. The micro controller processes the readings of the ultrasonic sensors in order to activate the motors by sending pulse width modulation. It also provides a low power consumption. The design of the device is light and very convenient. Furthermore, the system uses two sensors to overcome the issue of narrow cone angle. So, instead of covering two ranges, the ultrasonic devices cover three ranges. This does not only help in detecting obstacles, but also in locating them. However, the design could be better if the authors did not use the wood foundation that will be carried by the user most of the time. In addition, the system is not reliable and is limited to Android devices.

BLITAB

BLITAB is the World's first tactile tablet for blind and visually impaired people. BLITAB is a next curve Braille device for Braille reading and writing that displays one whole page Braille text at once, without any mechanical elements. It is like an e-book which instead of using a screen displays small physical bubbles. For the first time our users can have an overview of a whole document. It is an Android tablet combined with a smart Braille surface. Blitab is a multi-line Braille tablet that delivers real-time content to people with visual impairments. BLITAB offers completely new user experience for Braille and non-Braille readers via touch navigation, text-to-speech output and Perkins-style keyboard application. It allows a direct converting of any text file into Braille from USB sticks, Internet and obtaining information via NFC tags. BLITAB is not just a tablet, it is a platform for all existing and future software applications for blind readers. So we integrate and collaborate.



Infrared based Door Opening Detection System

The PIR sensor has a 3-pin connection. Pin 1 is the Vcc pin. It must be connected to 5V supply. Pin 2 is the Data Out pin. Pin 3 is the Ground pin. It must be connected to ground. We have successfully tested this PIR sensor in an Arduino board and got a maximum range of functioning was 35 feet. This sensor can be connected to a mobile IoT application or an alarm which can indicate the presence of another human to a visually challenged person. The principle component of the project is PIR Sensor. A Passive Infra-red Sensor, as the name shows, not emits active infrared rays but only detects them [16]. All humans emit infrared radiations in the form of body heat. The PIR Sensor can capture the difference between the room temperature and nearby body temperature by the form of change in infrared radiation pattern. This change in infrared pattern is converted to voltage signal

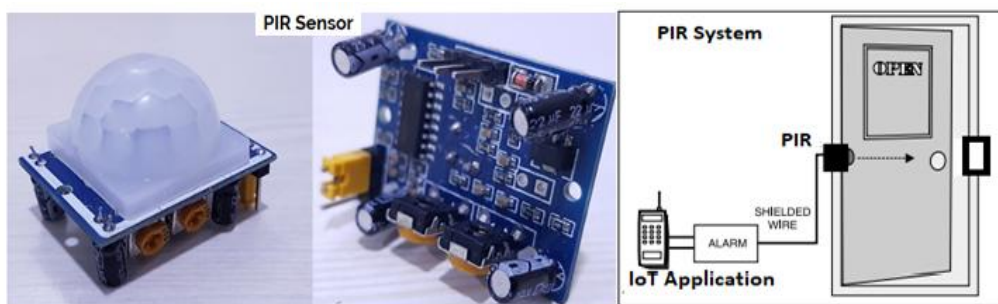


Figure- 2, PIR

System

The data out of a PIR Sensor could be given to a microcontroller or a Microprocessor for further processing or a controlling a motor, Alarm or feed into the IoT network

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