CHILD SAFETY MANAGEMENT USING WIRELESS TECHNOLOGY

[1]Afreen Qureshi, [2]Mohammed Anwaruddin
[1]PG Scholar, MTech, Dept of ECE, Nawab Shah Alam Khan College of Engineering and Technology, HYD, T.S.
afreenq400@gmail.com
[2]Asst Professor, Dept of ECE, Nawab Shah Alam Khan College of Engineering and Technology, HYD, T.S.

ABSTRACT

This paper discusses the concept of a smart wearable device for little children. The major advantage of this wearable over another wearable is that it can be used in any cellphone and doesn't necessarily require an expensive smartphone and not a very tech savvy individual to operate. The purpose of this device is to help parents locate their children with ease. At the moment there are many wearable's in the market which help track the daily activity of children and also help find the child using Wi-Fi and Bluetooth services present on the device. But Wi-Fi and Bluetooth appear to be an unreliable medium of communication between the parent and child. Therefore, the focus of this paper is to have an IOT enabled communication medium between the children's wearable and the parent as the environment for IOT mobile communication is almost present everywhere. The parent can send a text with specific keywords such as "LOCATION" etc., the wearable device will reply back with a text containing the real time accurate location of the child which upon tapping will provide directions to the child's location on Google maps app and will also provide the surrounding temperature index so that the parents can keep track if the temperature is not suitable for the child.

I. INTRODUCTION

The Internet of Things System (IoT) [1] refers to the set of devices and systems that stay interconnected with real-world sensors and actuators to the Internet. IoT includes many different systems like smart cars, wearable devices [2] and even human implanted devices, home automation systems [3] and lighting controls; smartphones which are increasingly being used to measure the world around them. Similarly, wireless sensor networks [4] that measure weather, flood defenses, tides and more. There are two key aspects to the IoT: the devices themselves and the server-side architecture that supports them [5]. The motivation for this wearable comes from the increasing need for safety for little children in current times as there could be scenarios of the child getting lost in the major crowded areas. This paper focusses on the key aspect that lost child can be helped by the people around the child and can play a significant role in the child's safety until reunited with the parents. Most of the wearable's available today are focused on providing the location, activity, etc. of the child to the parents via Wi-Fi [8] and Bluetooth [9]. But Wi- Fi and Bluetooth seem a very unreliable source to transfer information. Therefore, it is intended to use SMS as the mode of communication between the parent and child's wearable device, as this has fewer chances of failing compared to Wi-Fi and Bluetooth. The platform on which this project will be running on is the Arduino [10] Uno microcontroller board based on the ATmega328P, and the functions of sending and receiving SMS, calls and connecting to the internet which is provided by the Arduino GSM shield using the GSM network [11]. Also, additional modules employed which will provide the current location of the child to the parents via SMS. The second measure added is SOS Light indicator that will be programmed with Arduino UNO board to display the SOS signal using Morse code. The different modules stay enclosed in a custom designed 3D printed case [12]. In the scenario, a lost child can be located by the parent could send an SMS to the wearable device which would activate the SOS light feature on the wearable. Therefore, alerting the people around the child that the child is in some distress and needs assistance as the SOS signal is universally known as the signal for help needed. Additionally, the wearable comes equipped with a distress alarm buzzer which sets to active by sending the SMS keyword "BUZZ" to the wearable. Hence the buzzer is loud and can be heard by the parent from very considerable distance. Also, the parents via SMS can receive accurate coordinates of the child, which can help them locate the child with pinpoint accuracy. Some of the existing work done on these similar lines are for example the low-cost, lightweight Wristband Vital [2] which senses and reports hazardous surroundings for people who need immediate assistance such as children and seniors. It is based on a multi-sensor Arduino micro-system and a low power Bluetooth module.

II. SYSTEM DESIGN AND ARCHITECTURE

This section discusses the architecture and the design methodologies chosen for the development of the Child Safety wearable device.

A. SYSTEM OVERVIEW

A) Power Supply

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of

the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

B) ARDUINO UNO

An A Tmega328p microcontroller controls the system architecture of the wearable with an Arduino Uno boot- loader. A 5-pin header allows for power (+3 V) and ground connections as well as providing access to TX, RX, and reset pins of the ATMega328p. The Fig illustrates the architecture of the child safety wearable device, which depicts the various technologies and technological standards used. The system architecture of the wearable is based and controlled by an AT - mega328p microcontroller with an Arduino Uno boot loader. The Arduino Uno collects various types of data from the different modules interfaced to it, such as the GPS module upon being triggered by the Arduino GSM shield. The GSM shield is used as an interface to send the data received by the Arduino Uno via SMS or MMS to a smartphone over GSM GPRS. The GSM shield functions as a trigger for the Arduino Uno to request data from its various modules. If an SMS text with distinct characters is sent to request the current location or GPS coordinates is sent to the Arduino GSM shield via the user's smartphone, then the GSM shield triggers the Arduino Uno to request the current GPS coordinates. The GSM shield uses digital pins 2 and 3 for the software serial communication with the MIO. Pin2 is connected to the TX pin and pin 3 to its RX pin. The MI 0 is a Quad band GSM/GPRS modem that works at GSM850Mhz, GSM900Mhz, DCS1800Mhz, and PCS1900Mhz. It also supports TCP/UDP and HTTP protocols through a GPRS connection. Once the Arduino Uno has received at the coordinate information, it will process this information and transfer it over to the GSM shield, which then sends via SMS.

C) Temperature sensor

Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications. A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of environmental temperature.

D) MEMS SENSOR

An accelerometer is a micro-electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at our feet, or they could be dynamic - caused by moving or vibrating the accelerometer. There are many types of accelerometers developed and reported in the literature. The vast majority is based on piezoelectric crystals, but they are too big and too clumsy. People tried to develop something smaller, that could increase applicability and started searching in the field of microelectronics. They developed MEMS (micro electromechanical systems) accelerometers.

Block diagram

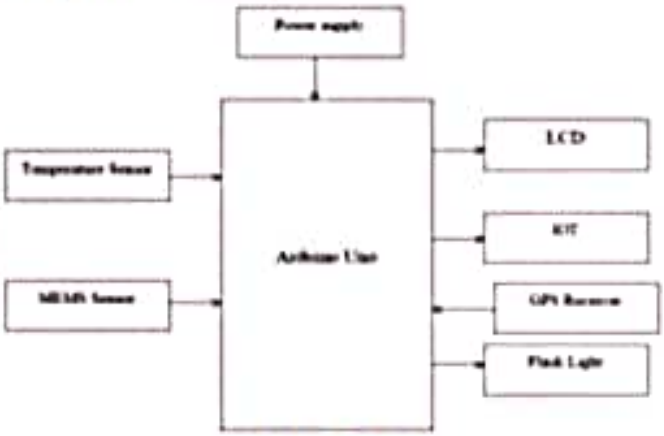

Fig1. Block Diagram

Fig 2. MEMS SENSOR

MEMS accelerometer use nanotechnology in order to enhance the natural abilities common between all accelerators, hence, these devices are extremely fine-tuned and accurate. MEMS stands for Micro Electro Mechanical Systems, and when discussing the technicalities of accelerometers, it refers specifically to a mass-displacer that can translate external forces such as gravity into kinetic motion energy. This part of the accelerometer usually contains some type of spring force in order to balance the external pressure and displace its

mass, thus leading to the motion that produces acceleration.

E) LIQUID CRYSTAL DISPLAY (LCD)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

Fig3. 16x2 LCD

F) ESP8266 WIFI IOT MODULE

Description:

- These modules include 1MB (8Mbit) of flash memory, twice the size of the older blue colored ESP-01 module
- The ESP8266 Serial/UART to WIFI module is a great way to connect your Arduino or other microcontroller projects to a Wi-Fi network
- Create your next internet of things (IOT) project with affordable network connectivity by implementing this module into your design
- The module has the ability to run independent of a host controller
- The eight-pin header includes two GPIO pins that allow for direct connection of the module to sensors, peripherals, or host controller
  - Check out our ESP8266 breadboard adapter to use your ESP8266 module with a breadboard
- The ESP8266 has 3.6V tolerant I/O's so you will need a logic level converter to connect it with higher voltage devices such as Arduino
- The ESP8266 requires 3.3V power so you may need a 3.3V voltage regulator to provide the correct voltage, depending on your setup

Product Contents:

- 1 — ESP8266 ESP-01 Wi-Fi Transceiver Module with baud rate set at 115200 bps
- 1 (per order) — Addicore ESP8266 info card (includes pinout diagram)

Specifications:

- 802.11 b/g/n
- Serial UART baud rate: 115200 bps
- Integrated TCP/IP protocol stack
- Input power: 3.3V (see "Recommended Accessories" below for 3.3V power options)
- I/O voltage tolerance: 3.6V Max (see "Recommended Accessories" below for level converters to connect to higher voltage devices (i.e. Arduino))
- Regular operation current draw: ~70mA
- Peak operating current draw: ~300mA
- Power down leakage current: <10µA
- +19.5dBm output in 802.11b mode
- Flash Memory Size: 1MB (8Mbit)
- Wi-Fi security modes: WPA, WPA2
- Module's dimensions: 24.75mm x 14.5mm (0.974" x 0.571")

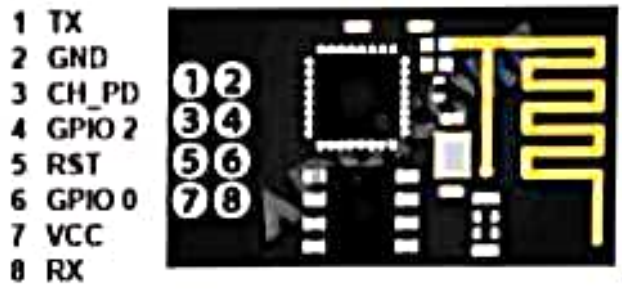

Fig4. ESP8266 Module

G) GLOBAL POSITIONING SYSTEM

The Global Positioning System (GPS) is a satellite-based navigation system that can be used to locate positions anywhere on earth. Designed and operated by the U.S. Department of Defense, it consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and uses triangulation to calculate a user's exact location. GPS is used on incidents in a variety of ways, such as:

GPS is made up of three parts: between 24 and 32 satellites orbiting the Earth, four control and

Fig10. LCD Displaying MEMS DETECTION

Fig11. IOT Mobile application Output

V. FUTURE SCOPE

1) Camera Module:

For surveillance of the child's surroundings, to get a clearer picture of the location, this wearable can also contain a camera module incorporated in it. The hardware that could be used would be an adafruit TTL serial camera. Since the major focus of this wearable project is the GSM module which is a better alternative than Bluetooth, Wi-Fi or ZigBee due to the short range and connectivity issues of these technologies. Therefore, for this project using the GSM technologies is beneficial as the cellular range is vast and since all the communication between the wearable and the user is taking place via SMS, therefore no internet connectivity is required at all. But, still, the Arduino GSM shield possess the added advantage of using GPRS which enables the board to use the internet if required. Whereas for the camera module which supports video streaming but due to the constraint of trying to use only SMS, therefore only four wire connections will be taking place. The red and black wires will be connected directly to +5V and GND respectively to the Arduino uno board. Whereas for the RX pin which will be used for sending data via Arduino uno and Arduino GSM board and for the TX pin which will be utilized for receiving incoming data via from the modules. The 10K resistor divider, the camera's serial data pins are 3.3v logic, and it would be a good idea to divide the 5V down so that its 2.5V. Normally the output from the digital 0 pin is 5V high, the way we connected the resistors is so the camera input (white wire) never goes above 3.3V. To talk to the camera, the Arduino uno will be using two digital pins and a software serial port to talk to the camera. Since the camera or the Arduino Uno do not have enough onboard memory to save snapshots clicked and store it temporarily, therefore an external storage source microSD breakout board will be used to save the images temporarily. The camera works on a standard baud rate of 38400 baud. The camera will be collecting information in the same manner as the GPS module. It will be on standby conserving power waiting for the particular keyword "SNAPSHOT" to be sent from the user's smartphone to the GSM shield will activate the camera to start clicking a snapshot of the surrounding and save the file temporarily on the external microSD card. After which Arduino Uno will access the saved image from the micro SD storage and transfer it to the GSM module which send it to the user via SMS/MMS text.

2) Android App:

The idea behind the Android app has been derived from having an automated bot to respond to text message responses from the user. It will provide the user with predefined response options at just the click of a button. The user doesn't need to memorize the specific keywords to send. Also, the bot will be preprogrammed to present the user with a set of predefined keyword options such as "LOCATION," "SNAPSHOT," "SOS," etc. Whereas for the future aspect of this wearable device based on what type sensor is added to it, additional specific keywords could be added such as, "HUMIDITY," "ALTITUDE," etc.

VI. CONCLUSIONS

The child safety wearable device is capable of acting as a smart IoT device. It provides parents with the real-time location, surrounding temperature, UV radiation index and SOS light along with Distress alarm buzzer for their child's surroundings and the ability to locate their child or alert bystanders in acting to rescue or comfort the child. The smart child safety wearable can be enhanced much more in the future by using highly compact Arduino modules such as the Lily Pad Arduino which can be sewed into fabrics. Also, a more power efficient model will have to be created which will be capable of holding the battery for a longer time.

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