



ADAPTIVE DISTANCE ALERT SAFETY SYSTEM (ADASS) ON CHILD TRACKING USING ARDUINO

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ABSTRACT

This paper presents a development of an Adaptive Distance Alert Safety System (ADASS) on child tracking using Arduino microcontroller. A developed prototype of ADASS is designed to alert guardians in detecting human or children presence in a selected covered area. It comprised with a portable module called transmitter which hold by a child and a receiver hold by a guardian. The module works as guards to keep alert on the child existence if the child goes beyond the selected safety area. The system designed which provides three adaptive different signals coverage with Arduino microcontroller. Adaptive signals and different sound volumes are alert in the distance alert area are set as 50m, 70m and 100m as the adaptive signals. Buzzer sounds is created to react with frequency signal and produces different levels sound strength which are low, medium and high volume followed the set of distance of the alert area. Short Message Service (SMS) is sent to guardian if the child is outside the signal range. The Communications signal for the alert system from transmitter to receiver uses Radio Frequency (RF) signal. The RF signal is analyzed based on the adaptive distance alert. Result presents a prototype of ADASS that designed with three new parameters and alerts evaluation is successfully identified in cases of child appearance.

Keywords: alert safety system, adaptive distance, arduino, radio frequency (RF), global system mobile (GSM), human guardian, short message service (SMS).

INTRODUCTION

Safety alert on human especially children is becoming a very concerned matters nowadays. Cases on kidnapping child are frequently happened especially in a public area. A survey has presented many system alerts are developed example using cellphone, android and Global Positioning System (GPS) [1]. Since technology is updated very fast, certain flaws occurs with the existing system like indoors [2], on the other hand new system needed to cater with new technology and reliability to new locations covered. One research presents a tracking system which is capable of detecting various danger surrounded by more than one child and trying to decrease the limitations that found in the present systems. The designed system consists of two modules which is parent module and child module [3]. But somehow the system is not adaptive which creates a simple safety system alert. Technology deployments are new factors on motivations to the new system development. Many engineering tools on sensors are also used with these technology like Arduino Controllers, Website with RFID sense and others [4, 5]. Many engineering tools on sensors are also used with these technologies like Arduino Controller. It is important to know child or valuables thing always safe even in areas far from the observations and out of sight. It also prevent from occurring cases of child abduction and missing that greatly feared by all parents and guardians.

This paper presents an analysis study on existing safety alert system implementations in order to design an Adaptive Distance Alert Safety System (ADASS). This safety system generated to keep your child in a safe condition even outside of the observations of parents and guardians. Three main objectives is derived and met which is firstly to design an ADASS prototype by using Sim900 GSM and Arduino Uno Microcontroller. Second

objective is met where the alert system detects presence of a human or child and safety of human that would be protected in a safe area. The third objective is met where ADASS is analyzed where the alert system can be controlled the safety of human in a selected distances. The method comprise of characterization and parameter evaluation which are compared with previous works to design ADASS. ADASS focus on adaptive alert with sound and covered area. The maximum range of RF transmitter and receiver circuit is in the 100 meters area. The system uses Arduino board to control all the input and output by using C program. The ranges of this system are divided into three differences amplitude of buzzer sounds which are when range outside 50 meters then low amplitude of buzzer is triggered, when range outside 70 meters then medium amplitude of buzzer is triggered and when range outside 100m then high amplitude of buzzer is triggered. Detail components are presented ADASS system development which is comprised of hardware, system flow, discussion and results.

RELATED WORK

Safety alert system

One previous research presented a multipurpose child tracking system which capable of detecting various danger surrounded by more than one child. The designed system consists of two modules which is parent module and child module. When a child abuse survivor is detected, the sensor module specifically on children produced a signal. The signal sent by the sensor to the controller later via a transmitter module that takes the necessary decisions and start infringement procedures. Parents can set the system to work indoor or outdoor. With both parents preferred module can calculate the distance at any time



between each child and their parents. GPS is used for outdoor distance calculation while change amplitude of RF Signal is used for indoor distance calculation. Parent can delimited the safety distance for each child and when it is overtaken the system then alarms both of parent and child. The system is simple which implemented on a single chip microcontroller with low cost [3].

Another study presents a tracking system for devices to address the phenomenon of child abduction [6, 7]. It is concerned about protecting children from child abduction phenomenon by using tracking systems such as GSM, General Packet Radio Service (GPRS) and GPS. System created shoes that draws in relation to belt containing a GPS tracking system that can be installed in all types of child shoes and reliable replacement with other shoes. Thus, this study is concerned to protect children against child abduction crime. The system is best designed for used to follow up the children in their home away from home and develop systems used in other communities. It is proven effectively system which reduced the incidence of child abduction. Another research also present tracking using GPS where coordinates used in time stamped, accessed by the microcontroller and sent to predetermined mobile phones via the GSM network [8]. This system combines the position location capabilities of the GPS (Global Positioning System) to identify the current location of the kidnapped person or stolen items.

Children positioning and identification system using marker recognition is designed to identify children in the classroom at a traditional kindergarten [9]. The system can identified coordinate of each children. Coordinates are used as a base to monitor children activity. Analyzed activities are reported to teachers and parents as a solution to the monitoring system. The implementation is done by using marker recognition library in AR Toolkit. In addition to the identification and positioning, the system also handled an automated children's attendance recording system.

Technology development

Research identified latest technology developments that have been used in Safety Alert system as listed.

- Global Positioning system (GPS) [2, 3, 6, 7, 10]
- GSM Wireless [6, 11-13]
- GPRS [6, 7]
- Radio Frequency (RF) [3] and RFID [14]
- Wireless Sensor Network [14]

Engineering tools

Research also identified among various engineering tools used in the system as listed.

- Arduino hardware [4]
- Automated Machine (AM) [15]
- Crossbow Motes [3]
- Sky Tek M8 [16]

METHODOLOGY

Figure-1 present the methodology flowchart for ADASS development. It comprised of study on related works, design framework, identify main components and development of ADASS based on identified parameters. On the development phase it comprised of overall systems overview, requirements components, and architecture and detail system flowchart.

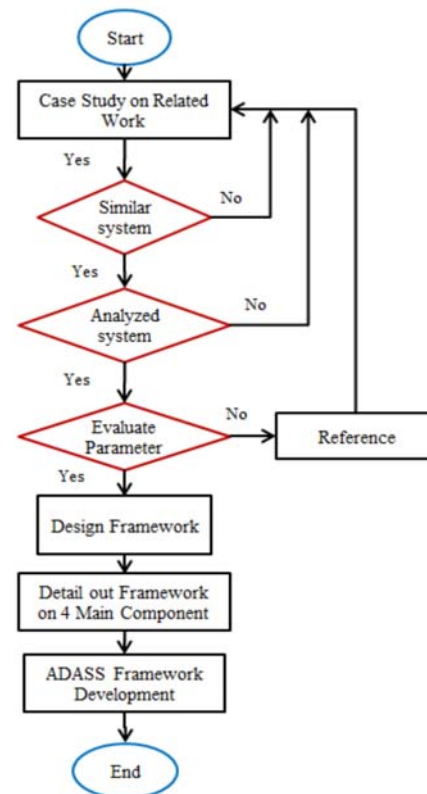


Figure-1. Flowchart to define ADASS system.

System Overview

ADASS system generated is to keep your child in a safe condition even outside of the observations of parents and guardians. This system also is to protect any of valuables thing in safe condition. This system is important to know child or valuables thing always safe even in areas far from the observations and out of sight. This safety system can also prevent from occurring cases of child abduction and missing that greatly feared by all parents and guardians. This system is using Arduino Uno hardware and software to control all the input and output in this system. To make the range between transmitter and receiver, this system using RF transmitter and receiver that is set 100 meters for maximum range. For the output we are using buzzer to alert people around and GSM to inform the guardian about the transmitter outside of the range.



System requirements

The main purpose of this system is to be used by human to always alert them about their valuable objects or people they care for always being with them even out of sight. By using this system, it can avoid any loss goods or kidnapping of a child. This system is created and develops by using simple components that easy to get in any types of components store. This system makes a tighter connection with Arduino platform. Open source solutions were proposed to construct this system and components such as GSM module, RF module and others used in the proposed safety alert system can be easily integrated with Arduino platform. It also a simple product that can easy to use by consumer.

System components

The main hardware components of the ADASS are RF module with 315MHz frequency which is transmitter and receiver. Arduino UNO as a platform of the system, GSM module as a device that can send message to the user and siren to alert guardian when the child out of range. Figure-2 shows the block diagram of ADASS system.

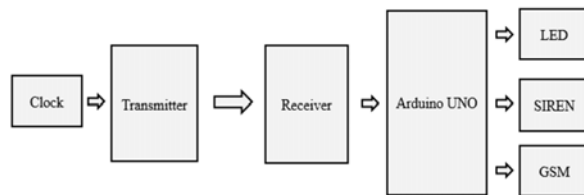


Figure-2. Block Diagram of ADASS system.

System architecture

There are three different range and amplitude of siren in ADASS system which is 50m, 70m and the maximum range is 100m. The child with transmitter module is to be in the specified range with guardian that hold receiver module as called the controlled area. Figure-3 shows the system architecture model of ADASS. The detailed schematics for the transmitter module and receiver module are shown in Figure-4.

System flowchart

Figure-5 present the overall system flowchart which consists of three main parts which is input, processor and output. The input is the RF transmitter module that is used to send signal to the RF receiver module. In this case, the maximum range of RF transmitter and receiver is 100 meters. Next is the processor where in this part consists of the Arduino Uno that makes this system work by using Arduino language which is

uploaded into Arduino board. Lastly is the output which is the buzzer and GSM Sim900 Module for sending an SMS to guardian. We can see the system function when the receiver cannot receive the signal.

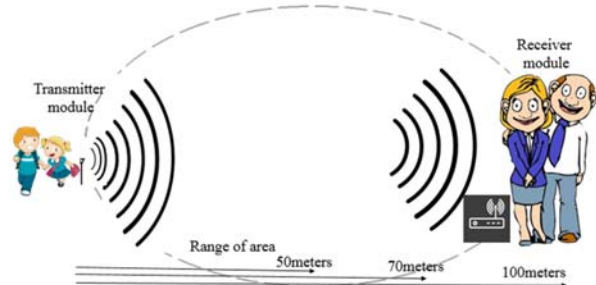


Figure-3. System architecture model.

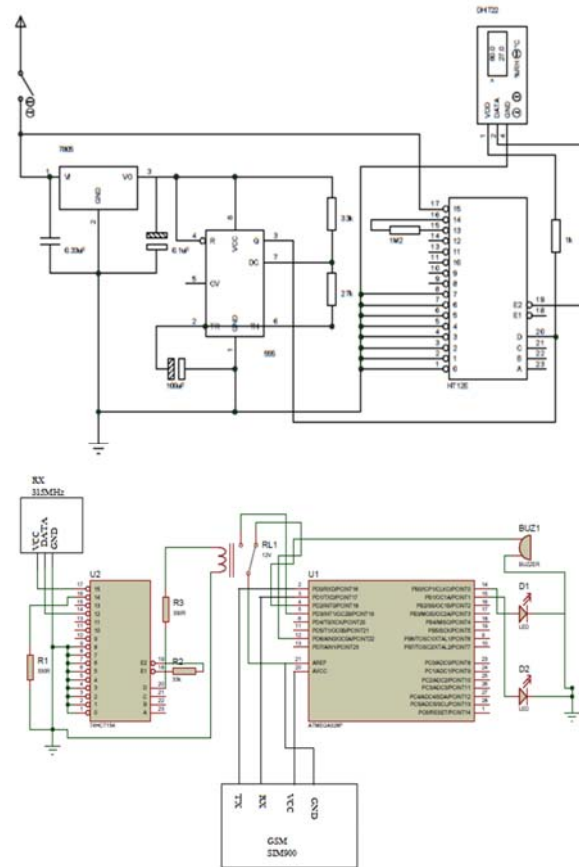


Figure-4. System schematic.

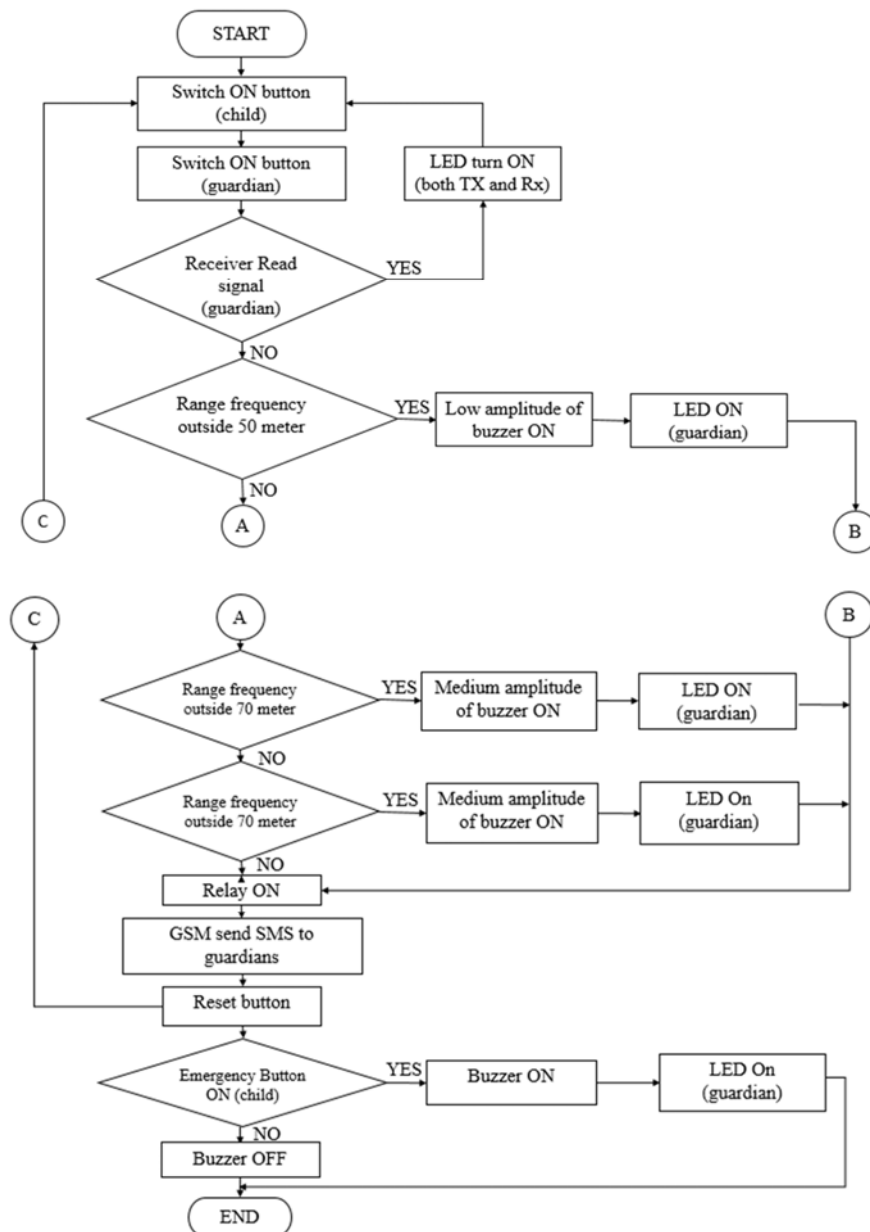


Figure-5. System flowchart.

RESULT AND DISCUSSIONS

Basic circuit

The Arduino Uno is used as a platform of ADASS system. This microcontroller processed by the receiver of RF then it produced with other option output. The transmitter module is hold by children as input in ADASS system with frequency 315MHz is processed using decoder. A decoder HT12D is used as a remote control applications that can control the receiver module. Signal is transmitted using a RF transmission medium and provides output after processing data. The decoder is paired with encoder HT12E that process with receiver of radio frequency. This RF module is identified that it is

sufficient to give a range of 100 meters in open region. The GSM SIM 900 and buzzer is used as output in this system. Its use as a device that alert guardian if the transmit module cannot connect to receiver module. Figure-6 shows the circuit of transmitter and receiver of ADASS system.

Power supply

This module is a portable module that can carry to anywhere. For the transmitter module, we are using power bank as power supply. Since the circuit only using 5V of supply in continuous time, therefor to avoid the device from get damaged we are using voltage regulator to fix to a constant voltage. For the receiver module we can



use adapter 1A or power bank as a power supply. It depend on the user to choose.

Clock (IC555)

The 555 timer IC integrated circuit (chip) used in a variety of timers, pulse generation, and oscillator applications. The 555 timer can be used to provide a delay time, oscillator, and a flip-flop element. Derivatives circuit provides up to four times in one package. This IC 555 timer is controlled for the time for the signal. So every 5 seconds, the transmitter part will send a signal to the receiver, which means it is automatically send the signal for every 5 seconds. Plus, the timer produces a clock wave showing that when it is 1 it receives signal and 0 when it does not receive signal.

Radio frequency

Radio frequency (RF) is a rate of oscillation in the range of around 3 KHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations; however, mechanical RF systems do exist (see mechanical filter and RF MEMS). To receive radio signals an antenna must be used. However, since the antenna picks up thousands of radio signals at a time, a radio tuner is necessary to tune into a particular frequency (or frequency range. Another method to isolate a particular radio frequency is by over sampling (which gets a wide range of frequencies) and picking out the frequencies of interest, as done in software defined radio. In the developed device, a transmitter part is attached at the kid so that in order for the signal to be sent to the receiver which is attached to the guardian.

Encoder and decoder

Encoder IC HT 12E is a series of CMOS LSIs for remote control system applications. It is capable of encoding 12-bit information consisting of N bit address and 12 N bit data. Any address or data input externally trinary programmable if bonded out. HT IC 12D is a series of CMOS LSIs for remote control system applications. IC is paired with each other. For proper operation of the encoder or decoder pair with the same number of address and data format should be selected. These decoders receive serial addresses and data from a corresponding decoder, transmitted by carriers using RF transmission media and provide the output to the output pin after the data processing. In this ADASS system we are using encoder in transmitter module using and decoder in receiver module.

Global System for Mobile (GSM) module

Global System for Mobile (GSM) Module [10] is device to send and receive the message from the user. This GPRS Shield is based on SIM900 module from SIMCOM and compatible with Arduino and its clones as show in figure 1.4 that one of the model GSM (Global System for Mobile Communications) SIM 900. The GPRS Shield provides users a way to communicate using the GSM cell phone network. The shield allows users to achieve SMS,

MMS, GPRS and Audio via UART by sending AT commands. The shield also has the 12 GPIOs, 2 PWMs and an ADC of the SIM900 module and it's all 2V8 logic present onboard. This GSM will send an SMS to guardian or parent when transmitter goes distance exceed 100 meters. This SMS to inform guardian and parent that their child goes beyond the maximum range.

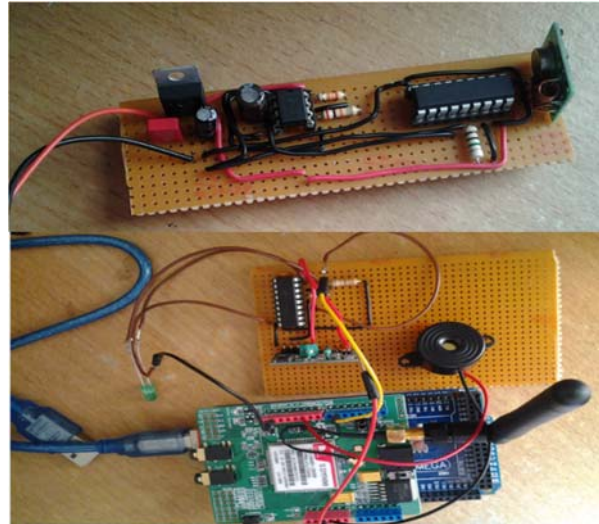


Figure-6. Transmitter and receiver circuit.



Figure-7. ADASS prototype.

ADASS system model and component with Arduino makes a tighter connection with Arduino platform. ADASS comprised of prototype hardware and programming system. Tested on the ADASS has been done. Results present successful ADASS prototype that generated adaptive alert with sound as shown in Table-1. The GSM will send short message service (SMS) to parents or guardian when the child goes to beyond 100 meters. An ADASS present continues system to evolve with changes technology for safety alert system that solves the problem in monitoring children. Thus, it helps people to alert and hopefully reduce cases on kidnapped children. Figure-7 show prototype of ADASS system.

**Table-1.** Result of testing distance range.

Distance range	Buzzer triggered	Short Message Service (SMS)
50 meters	Low amplitude	No
70 meter	Medium amplitude	No
100 meter	High amplitude	Yes

CONCLUSIONS

In this paper, the design an experimental testing of an Adaptive distance alert on safety system (ADASS) with Arduino Uno is designed. ADASS uses Arduino assembly language programs on a windows PC since the system also using Arduino as a microcontroller. The program is created and uploaded into the hardware system and the hardware functions according to the instruction. GSM module is used as a device that sends message to the user. The GPRS shield provides a way to communicate using GSM cell phone network. Besides that, Radio-Frequency (RF) to transmitter and receiver are implemented into this system provide a reliable location method. The system generates an adaptive alert with sound in three different level of volume. It is also continues to evolve with changes in the developed and equipped with great technology. An ADASS present continues system to evolve with changes technology for safety alert system that solves the problem in monitoring children. Thus, it helps people to alert and hopefully reduce cases on kidnapped children. With the creation of this system, hopefully more people responsible for ensuring the safety of goods and their children. In this project, three objectives have been met and system is successfully developed analyzed based on the designed alert criteria.

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