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DESIGN AND IMPLEMENTATION OF AUTOMATIC CHILD MONITORING (ACM) SYSTEM USING WIRELESS NETWORK

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Abstract—— Aiming at the increasing security risks of children, this paper presents and implements a kind of child monitoring system based on android phones to help guardian to acquire whether children are safe or not. ACM implements the software hand function and the danger zone function. The software hand function can monitoring the child's regular activities and the safety zone function can make guardians know children's location timely by using GPS sensors, acceleration sensors, and mobile GIS (Geographic Information System).

Keywords— safety monitoring; children; mobile GIS; safety area; danger factors

I. INTRODUCTION

In China, with the rapid development of urbanization and industrialization, rural resident population gradually reduces. According to the statistics by 2014, there are about 730, 000, 000 people in Chinese urban. More and more children live in cities. On one hand cities can provide a more favorable environment for children's living and learning, on the other hand they bring a huge challenge to the safety of children because of the complex environment of cities, such as many construction sites, a large number of running vehicles, a huge crowd and complex personnel structures. For children, they are inherently curious, active, and lack of safety knowledge and safety awareness necessary. In complex urban environment, it has become an important problem to meet the requirements of children security monitoring.

Video surveillance currently has been widely used to ensure the safety in Chinese communities and streets. However, there are usually a large number of blind zones in current video surveillance systems. The main purpose of monitoring is to guard against thieves or illegal actions. Furthermore, the monitoring system usually belongs to different departments, and children's parents or guardians haven rights to use them.

There are some research works for children safety. On children education, wang et al. studied the influence of classroom instruction [1], playing road traffic safety cartoon and realistic road traffic scenario safety education on the safety education effect of children in short-term, long-term, and memory effect stability respectively Bakar et al. presented the use of a courseware utilizing mixed learning environments which combines interactive, multimedia [2], Augmented Reality (AR) and Virtual Environment (VE) technologies to educate children and young people about safety knowledge and skills, and help them to train traffic habit. In dangerous detect, Cheng et al. present a

method of detecting children in the rear of vehicles [3], it uses the attention mechanism called Attention which consists of a window generation and verification cascade of based on Frequency-Tuned Saliency, Variation-Optical-Flow Obstacle Detection and finally a parts-based classifier. Finn et al. propose the design of a car safety seat that offers temporary thermal protection for the occupant [4]. The safety seat can keep the temperature of children under the survivability thresholds in a closed parked vehicle for up to 95 minutes. Takata et al. modeled the activity area for children by using the object-oriented method [5]. They divided the children activity places into a variety of accident areas, and realizes a simulation prototype. After that, They studied the use of GPS and map for child tracking [6]. Parents can view the position of children on the fixed computer or PDA. Lin et al. combined RFID with images to locate the children's position in kindergartens [7], and this system can raise alarm to nursing staff when children are in dangerous area. The RFID labels have also a temperature acquisition function, so that the nursing staff can know the change of temperature of children timely. Saranya et al. uses the ARM processor [8], GSM and GPS chip, sound playback chip to constitute children devices. The main functions of these systems are to track the positions of children, and sent them to their parents and the control room. Besides, they also can measure and identify children crying, and sent to parents and schools to timely treatment. Mori et al. used the wireless nodes with calibrated location in the campus to build a Mesh network [9]. Zejun et al used the Bluetooth in mobile phones for communication. These mobile phones can gather into clusters, and one of mobile phone was selected as the cluster leader. The cluster leader communicated with tags as a representative, sent the IDs of group members of the tags in order to track the position of the clusters[10]. According to the monitoring requirements from children's guardians of children's activity scope and activity states, this paper designed and developed a mobile monitoring system based on the Android mobile phones. It uses the widely used intelligent mobile phone as the hardware platform, and has the advantages of low cost and ease of use. By using these systems, the guardians of children can view the children's positions and activity states, which help to ensure the safety of children in dailylife. The rest of this paper is organized as follows. Section II presents the system structure of ACM. Section III describes the implementation of the software hand function and the safety zone function. Experiments and analysis are given in sectionIV. Finally, this paper concludes with sectionV.

II. SYSTEMSTRUCTURE

ACM is mainly composed of three block functions of showing n Fig. 1, the child unit will be attached with the child dress, the school unit will be available in the school for the database maintenance of each and every student in the school and the home unit will be with the parents which is used to find the location of the child in a cases if the child is missed in some crowdie places like park, mall etc..,

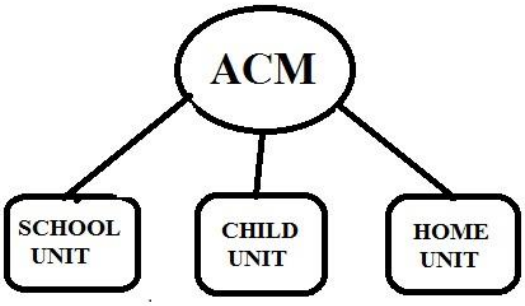

fig:1 ACM BLOCK

The school unit block is explained in Fig.2, which maintain the child databases. It consists of RFID reader which is used to read the RFID card available with child. Only with this card the student availability is maintained.

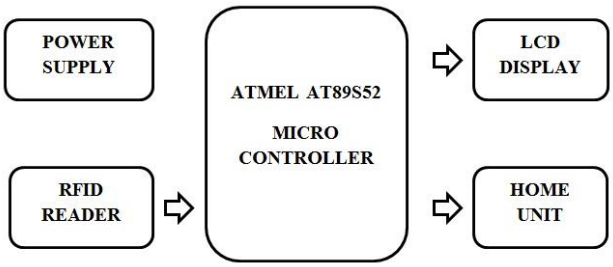

Fig .2 block diagram of school unit

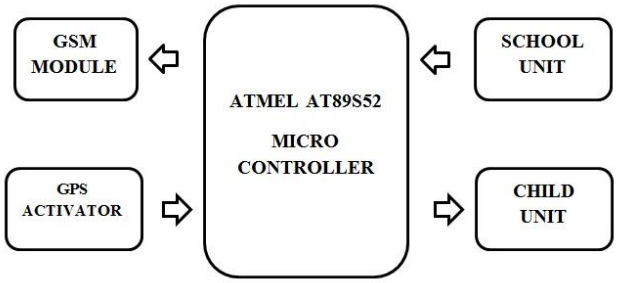

Fig. 3 block diagram of home unit

The home unit block is explained in Fig.3, which is available with the parents . It helps to activated the GPS module manually and find the location of the child ,if the child is being missed in any places.

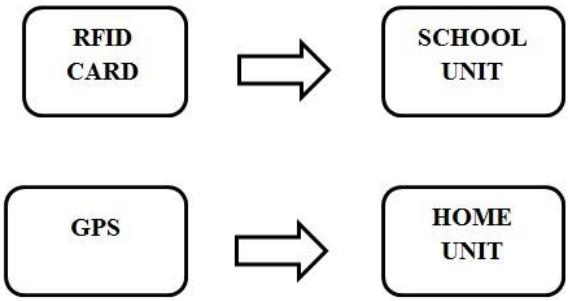

Fig. 4 block diagram of child unit

The child unit is explained in Fig.4, which is attached with the child. It consists of RFID card, GPS module which is used to find the location of the child if the child is being missed in crowd areas like park, mall, shopping complexes, etc..,

III. HARDWARE SYSTEM DESIGN

A.GPS

GPS is a multiple–satellite based radio positioning system in which each GPS satellite transmits data that allows user to precisely measure the distance from the selected satellite to his antenna and to compute position, velocity and time parameters to high degree of accuracy[4]. GPS delivers with high sensitivity and accuracy with low power consumption. GPS module design is flexible to accommodate various RF interference.

TABLE 1
FEATURE OF GSM

Parameters	Description
Chipset	SiRFStar III
Processor type	ARM7
TDMIChannels	20 receiver
L1frequency Protocol	NMEA
Outputprotocol message	GGA,GSA,
Baud rate	4800/9600 bps

B.GSM

The advantage of GSM is, its international roaming capability in over 100countries, improved battery life, efficient network design for less expensive System expansion, efficient use of spectrum advanced features such as short messaging and callerID, a wide variety of handsets and accessories, high stability mobile fax and data upto 9600 baud, Easy to use over air activation, and all account information is held in a smart card, which can be moved from hand set to hand set. The GSM module used in this project is SIM300 which offers all features mentioned above and serves as a medium between transmitter and receiver.

C. RADIO-FREQUENCY IDENTIFICATION (RFID)

Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader. Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader and may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

RFID tags are used in many industries. For example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line; RFID-tagged pharmaceuticals can be tracked through warehouses; and implanting RFID microchip sin livestock and pets allows positive identification of animals.

Since RFID tags can be attached to cash, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns.[2] These concerns resulted in standard specifications development addressing privacy and security issues. ISO/IEC 18000 and ISO/IEC 29167 use on-chip cryptography methods for untraceability, tag and reader authentication, and over-the-air privacy. ISO/IEC 20248 specifies a digital signature data structure for RFID and barcodes providing data, source and read method authenticity

A radio-frequency identification system uses *tags*, or *labels* attached to the objects to be identified. Two-way radio transmitter-receiver called interrogators or *readers* send a signal to the tag and read its response.

RFID tags can be either passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of an RFID reader. A passive tag is cheaper and smaller because it has no battery; instead, the tag uses the radio energy transmitted by the reader. However, to operate a passive tag, it must be illuminated with a power level roughly a thousand times stronger than for signal transmission. That makes a difference in interference and in exposure to radiation.

Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read/write, where object-specific data can be written into the tag by the system user. Field programmable tags may be write-once, read-multiple; "blank" tags may be written with an electronic product code by the user.

RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radiofrequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory. The RFID tag includes either fixed or programmable logic for processing the transmission and sensor data, respectively.

An RFID reader transmits an encoded radio signal to interrogate the tag. The RFID tag receives the message and then responds with its identification and other information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information. Since tags have individual serial numbers, the RFID system design can discriminate among several tags that might be within the range of the RFID reader and read them simultaneously.

Readers

RFID systems can be classified by the type of tag and reader. A **Passive Reader Active Tag** (**PRAT**) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). The reception range of a PRAT system reader can be adjusted from 1–2,000 feet (0–600 m)[1], allowing flexibility in applications such as asset protection and supervision.

An **Active Reader Passive Tag** (**ARPT**) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.

An **Active Reader Active Tag** (**ARAT**) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal.

Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles.

D. ATMEL MICROCONTROLLER (AT89S52)

The AT89S52 is a low-power, high-performance CMOS 8-bitmicrocontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non volatile memory technology and is compatible with the industry-standard 80C51instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non volatile memory programmer By combining a versatile 8-bit CPU within-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S52 provides the following standard features: 8Kbytes of Flash, 256bytes of RAM, 32I/O lines, Watchdogtimer, two data pointers, three 16-bittimer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

FEATURES OF AT89S52:

- Compatible with MCS®-51 Products
- 8KBytesof InSystem Programmable (ISP) Flash Memory
- 4.0Vto5.5V Operating Range
- Fully Static Operation:0Hzto33MHz
- Three-level Program Memory Lock
- 256x8-bitInternalRAM
- 32ProgrammableI/O Lines
- Three16-bitTimer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watch dogTimer
- Dual Data Pointer
- Power-off Flag
- Fast Programming Time
- Flexible ISP Programming(Byte and Page Mode)
- Green(Pb/Halide-free) Packaging Option

E.RF MODULE (TRANSMITTER & RECEIVER)

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK)

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its

antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.
The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

Pin Description: RF Transmitter

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

RF Receiver

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

IV. EXPERIMENTAL ANALYSIS AND OUTCOME

The child unit which is attached with the child dress, has a RFID card which will be activated when the child starts from the home to the school. If the child reaches the school and RFID card is being read by the RFID reader then no issues, the child is safe. In the case if the child doesn't reach the school on time and the card is not being read then the controller waits for some time and it sends information to both the caretaker in the school and also for the parents. The GPS module available with the child also gets activated and sends the location information to the parents mobile. The Fig.5 shows the position of the child by GPS module.

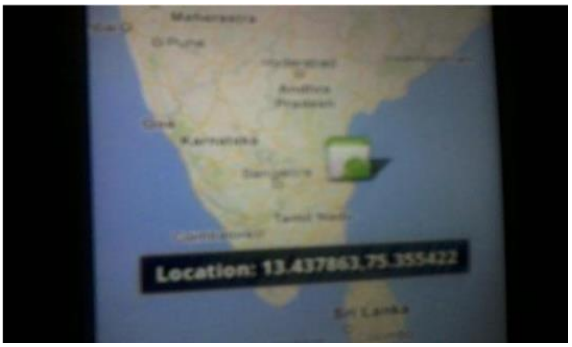

Fig.5 child position

The Fig.6 shows the module which is available with parents for receiving information. The GPS module can also be manually activated by the parents

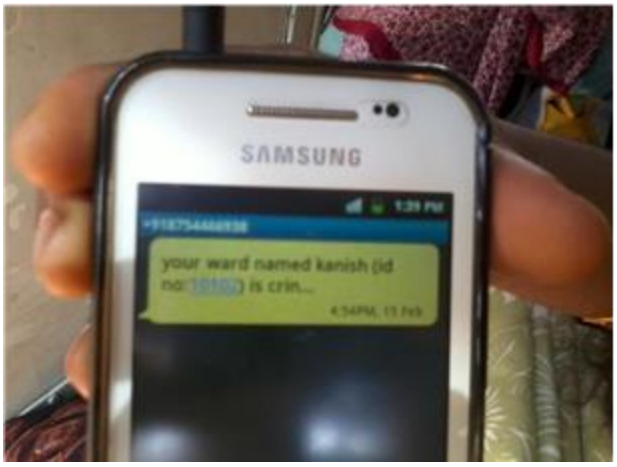

Fig.6 mobile unit

The home unit in which parents are noted , as already said the information regarding the child missing and position of child when the child is being missed will be received in the mobile unit which the parents have. The automatic and manual operation of GPS is done by this mobile which is handled and controlled by GSM module. The Fig.7 shows GSM module.

Fig.7 GSM module

The school unit which has RFID reader to check the children availability. It maintains separated databases for all students. If the child is found missing it will automatically intimated to the caretaker whose is available at the school and also to the parents.

V. CONCLUSION AND FUTUREWORK

This paper developed a ACM system which can improve children's safety. ACM enhances the safety of children respectively from preventing the children out of the guardian's sight and detecting whether children is in the safetyzones. ACM can meet the need of children to improve personal safety.

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