Design And Implementation Of Child Activity Recognition Using Accelerometer And RFID Cards

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Abstract— **In this paper we describe the method of recognition of a child activity of both sexes up to the age of 16 to 29 months by using 3-axis accelerometers on leg, hand and waist of the body to prevent child accidents such as unintentional injuries at home. Falls are a major cause of injury in children. Child activities are classified into 6 daily activities which are rolling, standing still, sitting down, walking, toddling crawling.**

Index Terms— **Accelerometer, activity recognition, child care, wearable device, RFID.**

I. INTRODUCTION

Usually the babies of the age between 9 and 16 months starts walking and they are at a risk of falling down from stairs or furnitures. As toddlers will learn jumping and climbing they are at risk of falling from windows and beds. The major cause of injury in children are falling. Accident and emergency departments and outpatient surveillance systems have declared that falls are the major common mechanism of injuries that required a medical care. In children less than 4years most fall related injuries will occur at home hence to prevent child home accidents a new safety management is required. Hence children falling has to be prevented[1].

Multi-channel accelerometry with calibrated sensors are very promising methodology have many advantages. The actual posture and the pattern of motion are basically provides a frame of reference for the evaluation of many behaviors, symptoms and physiological changes. The detection of body rotation may be important for more precise evaluation of nightly blood pressure changes since the blood pressure measurement refers to the level of the heart[2].

Accelerometers are embedded within wrist bands, bracelets, adhesive patches and belts. The data from sensor is sent to mobile computing device through wireless communication. The computing device analyze the received signal and recognize the user activity. Activity recognition can be performed by collecting acceleration data from multiple locations on the body.

In all previous works with multiple accelerometers have used accelerometers connected with wires, which may restrict object movement.

Multiple sensors are more accurate for collecting different types of sensing information but it is very inconvenient for users. Hence only one single unit of sensor node is used, which collects multiple types of information[3].

There are many ways to recognize the daily activities of people. One way to visually detect people's movement by using cameras. The drawback of this solution is that recognizing of a moving person requires a large number of cameras which is of high cost.

Another way by using personal companion devices such as mobile phones or watches with sensing and computing power to detect physical activities.

The watches are normally weared on the wrist. Hence the casual movement of arms doesn't have a direct and obvious relationship with ongoing activities, also modern watches are not so powerful enough to perform the data processing. Therefore personal watches has a lot of constraints in detecting physical activities.

Mobile phones are being more intelligent and powerful. When they are carried by people in pockets or bags, they are moving with the pace of the human body. Hence they appear to be the ideal platforms for detecting people's physical activities such as sitting, walking, running and etc[4].

Activity recognition by using accelerometers could improve the quality of care provided to patients and also used to observe the lifestyle and behaviour changes for healthy subjects.

One limitation is that wearable accelerometers are difficult to predict which locations on the body can provide exact features with respect to activity classification.

Another limitation is that single accelerometer cannot enough to provide sufficient contextual information and they need to be combined with other sensors such as microphones and ECG sensors to provide more accurate activity classification[5].

Wearable devices are developed to objectively capture physical activity type, duration and intensity by analysing information on body movement. These tools are called activity monitors. Activity recognition has been focused on the use of inertial sensors, e.g. micro machined accelerometers which is used to measure body movements and to determine the activity type.

Manuscript received Feb, 2013.

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ISSN: 2278 – 1323

These sensors are usually low power consumption and comparatively low cost of manufacture[6].

Multi sensors are used to monitor daily life of elderly people and children at home. This approach is trained using manually annotated data and applied for activity recognition. A waist- worn sensor could fail to detect activities involving head motion, body tilt, and hand motion. Multiple sensors are used to improve the robustness of the systems and increase the reliability of the high-level decision making.

Accelerometers are the most broadly used sensors to recognize activities such as walking and running, and also inexpensive, require relatively low power, and are embedded in most of cellular phones[7].

Radio Frequency Identification(RFID) is an automatic identification technology. Its characteristics are precise and continuous automatic identification capability.

Radio frequency identification (RFID) technology has been in use for several decades to track and identify goods, assets and even living things.

In the past, RFID is used to trace the movement and existence of goods. RFID can provide a direct and continuing recognition, including the identification, position, and trace of children[8].

II. SYSTEM BLOCK DIAGRAM AND HARDWARE IMPLEMENTATION

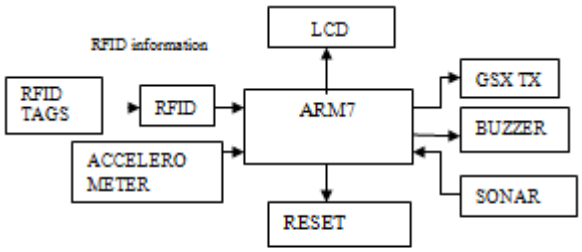

Fig 1: Block diagram of Child activity recognition

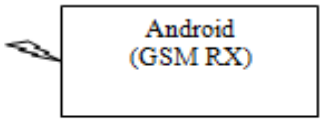

Fig 2: Sensing module

ARM7 is the heart of the system which controls all the blocks of the system shown in the fig.1. To observe the child and to show all the activities of the child in home, accelerometer and RFID card (NFC Cards) are attached. Where accelerometer detects child present and falling stages through its axis and RFID card will be read by RFID reader. Which will acts as near field communication. RFID card is attached to table or bulky items. Buzzer will be used which acts as an alarm and it is used to make sound when child come towards harmful objects. GSM is used for getting message to their parents/guardians for take care, where the parents/guardians mobile consists of android application to graph the child activities. The SONAR(Sound navigation & ranging) is used in this system to detect the bulky or huge materials in front of child and voice output will comes in android mobile.

A. Acccelerometer

ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 uses a single structure for showing the X, Y, and Z axes. As a result, the three axes' shows directions. They are highly orthogonal and have little cross-axis sensitivity.

B. Sonar

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function. The range of accuracy can reach to 3mm. The module contains ultrasonic transmitter, receiver and control circuit.

C. RFID

Radio-frequency identification (RFID) is an automatic identification method. RFID tags or transponders are used to store and retrieve data. The technology requires some extent of cooperation of an RFID reader and an RFID tag. An RFID tag can be used for identification and tracking purpose using radio waves RFID tag can be applied or incorporated into a products, animals, or peoples. Some tags can be read from several meters away and beyond the line of sight of the reader.

D. Buzzer

A piezo buzzer is driven by square waves (V p-p). A piezo buzzer can make higher SPL with higher capacitance, but it consumes more electricity. The sound output is measured by decibel meter. Applying voltage and square waves, and the distance of 10 cm. A buzzer can make sound on any frequencies, keep working well between -30°C and +70°C.

E. ARM7

1. It is 32 bit and single port device IC voltage will vary from 1.8 to 3.3v.
2. Low power consumption
3. 12v power supply
4. 12Mhz provided by crystal oscillator.

F. Android

1. Android is a software stack used in mobile devices that includes an operating system, middleware and key applications.
2. July 2005, Google acquired Android.
3. November 2007, Open Handset Alliance formed to develop open standards for mobile devices
4. October 2008, Android available as open source

G. GSM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM has established in 1982 is the name of a standardization group to create a common European mobile telephone standard. AT Commands are used to get information in SIM card.

H. LCD (Liquid Crystal Display)

LCD is a thin and flat electronic visual display. A liquid crystal display uses the light modulating properties of Liquid Crystals (LCs). LCs does not emit light directly.LCD is a 2

line display each line consists of 16 pins. It has the operating voltage is 5v.

LCDs uses very low power than the Cathode-Ray Tube (CRT) counterparts. LCDs use only atmosphere light to illuminate the display because they are ruminative.

Even displays that do consume much less power than CRT devices require an external light source (i.e. computer displays).

SOFTWARE IMPLEMENTATION

Figure 3 shows the program flow, when setup is powered up, it initializes LCD, ADC, UART. Configure the ADC to read the data of sensors. The obtained ADC values are compared with reference values. If the obtained values are less than reference value then activity of child will be recognized. The activity of child can be extracted by swiping the RFID tag. When RFID is swiped the unique ID is sent to the controller. By processing the ID, the activity of child is displayed on LCD and also the records are sent to their parents via GSM.

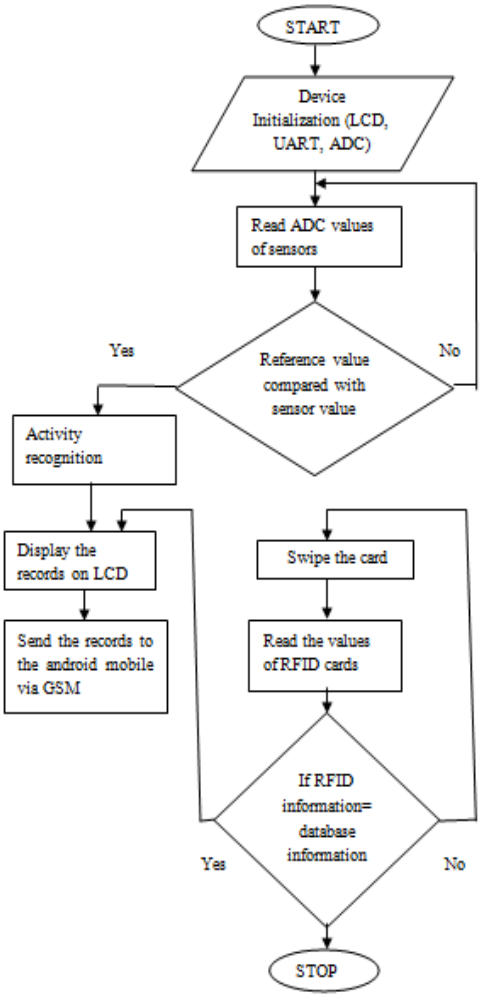

Fig 3: Program flow

Results

Voltage values of sensors are noted in the below table. Depending on the values child activity will be recognized and displayed on LCD and also sent to their parents via GSM.

Table I :Voltage values of sensors

Position	Leg	Hand	Back x	Back y
Sitting down	1.39V	1.26V	1.20V	1.47V
Standing still	1.21V	1.24V	1.20V	1.51V
Walking	1.29V	1.31V	1.20V	1.51V
Toddling	1.47V	1.61V	1.21V	1.52V
Crawling	1.32V	1.33V	1.45V	1.48V
Rolling	1.55V	1.38V	1.51V	1.80V

IV. APPLICATION

1. Multi sensors are used to daily life monitoring for elderly people and children at home.
2. Accelerometers are used to improve the quality of care for patients and to observe the child activities.
3. NFC is used to increase patient safety

V. CONCLUSION

This paper proposes the activity recognition method for children, to prevent child accidents. Child activity can be performed by using a triaxial accelerometer. To overcome the problem is that the multisensory are inconvenient for users. As well as reduce the cost of the system. Accelerometer detects child present and falling stages through its axis By using the accelerometer child activity will be recognized displayed on LCD and also sent to their parents via GSM.

ACKNOWLEDGMENT

We would like to express our sincere thanks to the anonymous reviewers for their critical suggestions which helped in improving the manuscript and also we express our gratitude to our respected faculty and our parents for supporting this work.

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