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An Innovative Monitoring Application for Child Safety

Pooja.K.Biradar¹, Prof S.B.Jamge²

P.G. Student, Dept. of Electronics, Walchand Institute of Technology, Solapur, Maharashtra, India¹

Associate Professor, Dept. of Electronics, Walchand Institute of Technology, Solapur, Maharashtra, India²

ABSTRACT: This paper provides an overview of a proposed dissertation work - An innovative monitoring application for child safety. This project proposes a child activity recognition device using a 3-axis accelerometer worn on a waist of the body to prevent child accidents such as unintentional injuries at home. Child activities are classified into many daily activities such as standing still, standing up, sitting down, walking, climbing up, climbing down etc. The proposed system consists of two parts, a wearable system for child designed using embedded platform and a guardian system installed on PC/laptop.

KEYWORDS: LilyPadArduino, Accelerometer/Gyroscope, RF communication module

I. INTRODUCTION

There is an increasing need to have easily deployable and autonomous technical devices to support the safety and well-being of children in nurseries, daycarecenters and primary schools. Additionally and not negligibly, these new devices should also ease the burden of the parents in their daily routines. Therefore, carefully designed solutions could provide more resources and time for the actual duties of parents, instead of spending time on safety issues. There are already a great variety of sensors and devices deployed in schools, roads and at homes, and more are expected in the near future. However, utilizing these multiple sensors and the information that they provide is not straightforward, as often the data is not easily accessible or available. Also difficulties arise, when managing the multi-sensor data in order to make intelligent reasoning, and to be able to draw conclusions about the children's safety and well-being.

In our work a wearable safety shirt, which is part of the presented scenario, would automatically provide information about the position of the child from their location. In addition, the safety shirt would gather other sensor information about the overall activity of the child, through Accelerometer sensors. There are many things to consider when talking about children's safety and well-being in home. Our research and implementation is providing solutions to some of these issues regarding the child's indoor activities.

Our safety shirt framework consists of two main building components:

- Wearable system - One demonstration safety shirt equipped with LilyPadArduino, Accelerometer and RF communication module that collect information from sensors and send it wirelessly through the RF communication module to the Arduino network gateway.
- Guardian system - The data obtained from the sensor devices are processed in controller. The collected parameters from the child are transmitted to the remotely located monitoring system using RF communication. The signals implemented using MATLAB, are used by the system to detect the child's activity. An alarm is generated depending upon the output of the system, to warn the guardian about the situation.

As babies usually start walking between 9 and 16 months they are at risk of falling from furniture or stairs. As toddlers learn to climb, they are at risk of falling from windows and beds. Falls are a frequent cause of injury in children. Accident and emergency departments and outpatient surveillance systems show that falls are one of the most common mechanisms of injuries that require medical care, and the most to prevent child home accidents. Since the

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major causes of fall-related injuries change as a child grows and develops, fall prevention needs to be addressed. One of the most challenging issues in this context is to classify daily activities of children into safe and dangerous activities.

Sensors embedded in a wearable device are more accurate for collecting different types of sensing information, but would be very inconvenient for users. For this reason, this proposed project uses only one single unit of sensor nodes, which collects multiple types of information.

II. RELATED WORK

Although numerous approaches [1]–[3] have proposed various activity recognition methods, human activity recognition is one of the challenging issues in terms of accurate recognition. In general, a pervasive safety management system aims to reduce risk factors of injuries to prevent accidents by using smart sensors. Multisensory fusion has been applied to daily life monitoring for elderly people and children at home [4], [5]. This approach trained using manually annotated data and applied for activity recognition. Zhu et al. [6] also suggested human activity recognition by fusing two wearable inertial sensors attached to one foot and the waist of a human subject, respectively. The use of multiple sensors has been shown to improve the robustness of the classification systems and enhance the reliability of the high-level decision making. On the other hand, a waist worn sensor could fail to detect activities involving head motion, body tilt, and hand motion. In addition to that and for the purpose of minimizing the number of sensors worn, it is important to know the capability of a certain position to classify a set of activities. Recently, Atallah et al. [7] investigated the effects of sensor position and feature selection on activity classification tasks using accelerometers. Accelerometers are not only the most broadly used sensors to recognize ambulation activities such as walking and running, but also inexpensive, require relatively low power, and are embedded in most of cellular phones. Their study concluded that optimal sensor positions depend on the activities being performed by the subject. Other important factors to consider, especially if the system is designed for long and continuous use, are how comfortable it is to wear and how easy it is to put on. Frequently, accuracy must be compromised for ease of use and comfort, due to a reduction in number of sensors. The optimal system configuration is, therefore, difficult to evaluate. It depends not only on the accuracy of the system but also on other practical aspects. In our study, for children under three years of age, the waist-worn sensor is put in a diaper to minimize uncomfortableness during physical activity and to measure body motions such as climbing up and climbing down than head, hand, and leg motion.

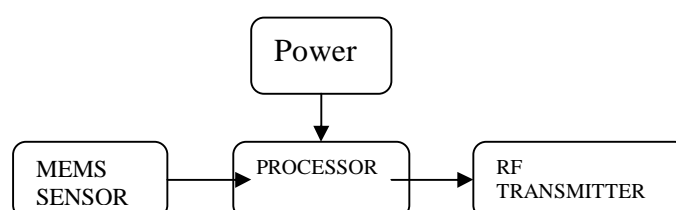
III. SYSTEM DESIGN

The main objectives of this project is to develop a wearable device consisting of a single-triaxial accelerometer which helps in recognizing baby activities which are dangerous and can cause accidents.

- The collected parameters from the child are transmitted to the remotely located monitoring system using RF communication.
- The signals processed using MATLAB, are used by the system to detect the child's activity.
- An alarm is generated depending upon the output of the system, to warn the guardian about the situation.

Wearable System

The below block diagram shows the flow of working of the security shirt



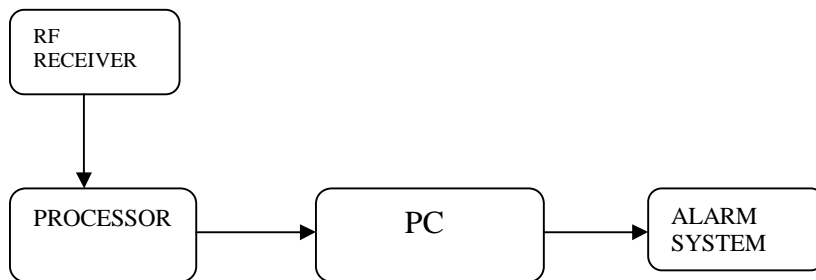
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GUARDIAN SYSTEM

The below block diagram shows the flow of working of the guardian system.



IV. PROPOSED SYSTEM

The proposed system consists of three main components:

- The wearable sensor node to measure movement and height from the ground by using a 3-axis accelerometer.
- The wireless receiver to receive the measured data over wireless protocol and transmit it to the processor.
- An alarming system to generate emergency alerts to their parents or a guardian.

All the components such as sensor, RF module are interfaced to the processor. The MEMS device finds the angular measurement of the child which detects the present and falling stages through its axis.

The data obtained from the MEMS devices are processed in controller. The collected parameters from the child are transmitted to the remotely located monitoring system using RF communication. The signals implemented using MATLAB, are used by the system to detect the child's activity. An alarm is generated depending upon the output of the system, to warn the guardian about the situation.

The compilation of the proposed system is as shown below

WEARABLE SYSTEM



GUARDIAN SYSTEM



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V. EXPERIMENTAL RESULTS

IMAGE 1

This output is shown when the child has fallen and needs attention. The alarm is generated at this output.

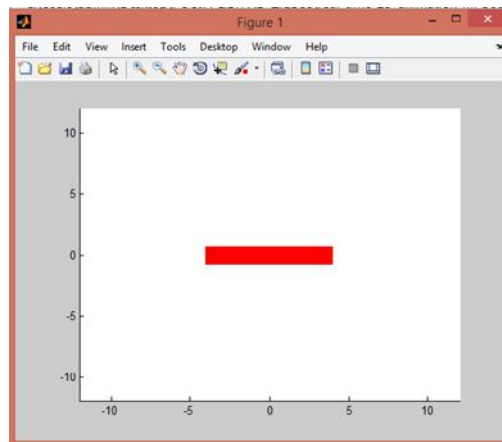
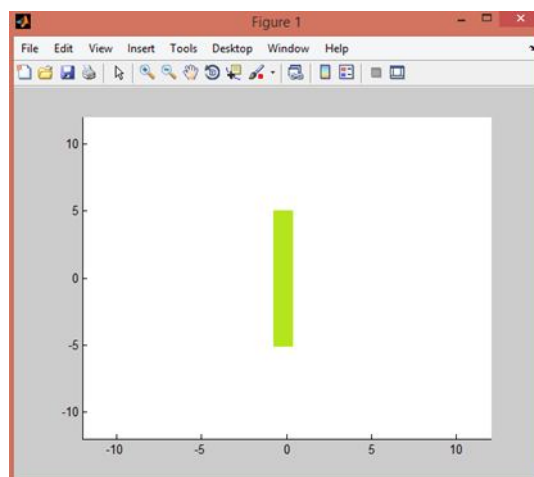


IMAGE 2

This output is shown when the child is fine. The alarm is not generated at this result.



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VI. CONCLUSION

The project work proposes the activity recognition for children to prevent child accidents. Using accelerometer child activity is recognized and appropriate alarm is generated to alert the guardian to avoid accidents related to the child.

VII. ACKNOWLEDGEMENT

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BIOGRAPHY



Pooja.K.Biradar has received the B.E.degree in Instrumentation Technology from PoojyaDoddappaAppacollege of engineering, Gulbarga in 2012. Currently she is pursuing Master in Engineering from Walchand Institute of Technology Solapur, in Electronics branch.



Prof S.B.Jamge has completed his M.TECH in Power Electronics in 2002 at VTU Belgaum. Currently he is pursuing Ph.D in Electronics Engineering at Solapur University. His area of interest is reliability Engineering