E-HEALTH PREVENTING PEDIATRIC HOME ACCIDENTS

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ABSTRACT

Pediatric home accidents still a nightmare for parents, especially for who don't know how to act in such situations. With the digital health advancements, it will be possible to avoid the disasters of these accidents, especially falls. In this paper, we will present the definition of each of home accidents and ehealth, the motivations and the challenges of this work, related works and propose a prototype to avoid falls disasters with a discussion of the positive and negative points of this prototype and finally make a comparison between our approach and the related works.

KEYWORDS

Home accidents, Fall, Children, E-health.

1. INTRODUCTION

Most people think that the house is a safe place, especially for children, but this belief is wrong. Rather, the house is a place full of dangers that the child may face in his life. When he grows up, his feeling of curiosity increases to discover the surroundings around him.

In this work, we will present the definition of the accident, the domestic accident, the e-health and how this new field of connected health will be able to upset the field of health by proposing solutions and easy access to care anywhere and anytime. Then we present the main motivations of this work and how to avoid the complications of domestic accidents and the issues facing this research.

This paper is structured as follows: Section 2 will present a background that gathers a set of key words and their definitions which are related to our problem. Section 3 will present the motivations and the challenges of this work. Related works will be presented in section 4. Section 5 details our application prototype. Section 6 is discussion about the works previously mentioned in section 4 in relation with our work. Lastly, the conclusion and future work is presented in Section 7.

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2. BACKGROUND

We describe in this section the main concepts of our work.

i) Home accident

According to the World Health Organization, an accident is an unexpected and unintentional event causing physical and mental injury. A home accident is an accident that happens at home, commonly occur in children.

ii) E-health

E-health or connected health is the use of the ICT (Information and Communication Technologies) and NICT (New Information and Communication Technologies) to support the health- care services.

3. MOTIVATION AND CHALLENGES

In this section, we will highlight the motivations for this work, as well as the challenges posed to our proposal.

3.1. Motivation

According to statistics represented by "Figure 1", 3.5 million children had been the victims for unintentional injuries related to falls, hits, cut, fire, poisoning, suffocation and drawing .Nearly 2 million children aged 12 years and under were victims for fall alone[1].

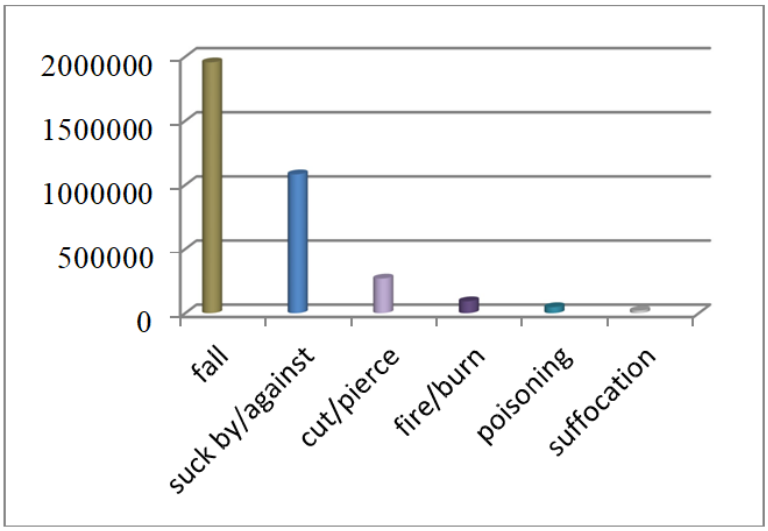

Figure.1. Unintentional non-fatal injuries that commonly happen in the home, by mechanism, 2013, children 12 and under

A lot of parents don't know how to act if their child falls, that was among the reasons that lead some children to die.

[1] www.safekids.org"report to the nation: protecting children in your home".

This consequence was a main reason to think of a prototype to avoid the maximum of falling results, by showing the parents what to do if their child felt.

3.2. Challenges

Saving child's life, poses challenges which are [1,2,3,4]:

- Rapid intervention for one or the both of parents
- Monitoring vital signs by the medical professionals
- Rapid intervention for the emergency.

4. RELATED WORKS

In this section, we are going to present some of selected works that is related to pediatric home accidents.

1. Home safety program: it's an intervention for parents of children who are up to 2 years of ages to prevent home accidents [5].
2. "Be khair" application: it's an application that offers all services in case a home accident happens such as first aid, medical card and emergencies phone numbers [6].
3. SADEM dedicated to drug intoxication for children: A system based on Cloud and uses RBR (Related Bed Rest) to find to right treatment in case the drug is known, if not, it uses a RBC (Case-Based Reasoning) to look for a similar case of the intoxication [7, 8].
4. Fat belly first aid application[2] : Application that offers all the necessary first aid in case of an accident [9].
5. Human falling detector based on multisensory data fusion for elder people: Algorithm was created to detect elderly falls, and use wearable devices [10].
6. St John ambulance first aid application[3] : application that offers illustrated and audio instructions in case of accident [11].

Table I. Advantages and disadvantages of related work

Works/Ref	advantages	disadvantages
1.Home safety program(2016) [5]	-Provides: safety devices, education, safety video, and home safety checklist to parents of children up to 2 years.	//
2."Be khair" application(2017) [6]	Contains: -First aid and guide for prevention supported with illustrations. -Medical card. -Phone book.[6]	-Doesn't support voice instructions.
3.SADEM dedicated to drug intoxication(2019) [7]	-It's dedicated to drug intoxication for children -It uses a RBR to give the right diagnosis and protocol to follow it in case the drug is known. -If not, it uses RBC to look for similar case of the intoxication.	-It's only adapted for drug intoxication. -This system is based on Cloud, which poses the problem of safety.

[2] https://play.google.com/store/apps/details?id=com.fatbelly.firstaidsandemergencytechniques
[3] https://play.google.com/store/apps/details?id=com.sja.firstaid

4.Fat belly first aid application(2019) [9]	-Include the first aid advice to deal with the emergency. -Contains calling emergency services.	-Contains ads. -Doesn't support illustrated guides and voice instructions.
5.Human falling detector based on multisensory for elder people(2020) [10]	-Supported with an alarm if human body falls. -Not limited by time and space -Low cost -Privacy [12]	-Poses a problem of flexibility -Limited battery life -Wrong alarms [12]
6.St John ambulance first aid application(2020) [11]	-Include the latest first aid advice to deal with the emergency. -Supported with illustrated guides and voice instructions.	-Doesn't replace the benefits of learning first aid.

5. OUR APPROACH

In this section, we proposed a prototype to prevent pediatric home accidents for both child and parents from the previous works.

5.1. For the child

Falling and EEG wearable detectors.as shown in Figure 2.

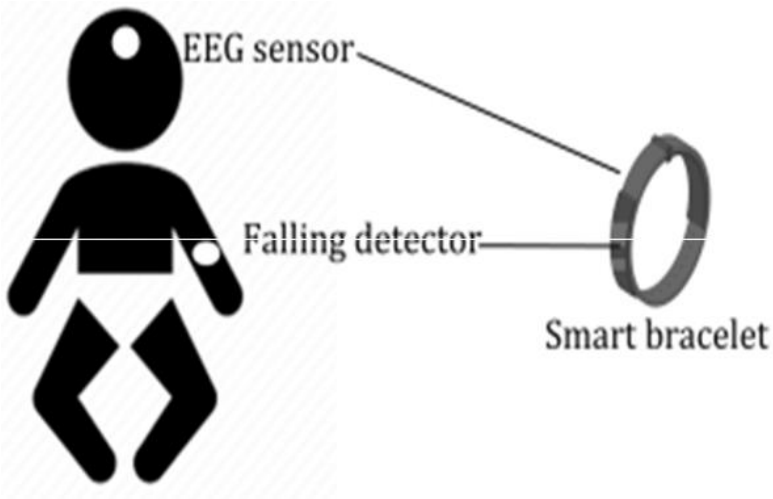

Figure 2. Architecture of falling and EEG sensor

5.1.1. A Falling Detector (See Figure 4)

In the supervision of children, the fall detector represents an essential element for remote supervision (Figure 4).

- The falling detector is based on acceleration calculation in 3D system (x, y, z) [13,14].
- After the calculation, this last will be compared to the ADL (Activity Daily Living) acceleration such as sitting down, walking and crawling [13].
- If the calculated acceleration was bigger than the ADL one that means that the child felt (as shown in Figure 3).

```
begin
   Variables: X, Y : real
   Y=Calculating acceleration // the detector
calculats the acceleration of the body in 3 axis
   X= A_adl // the acceleration of the daily
activity  living
   If ( Y> X) then « a fall is detected »
   else « no fall »
end
```

Figure 3. Algorithm shows how falling detector works

5.1.2. The EEG sensor

The EEG sensor is an essential sensor for monitoring,

- The EEG sensor is used to monitor the state of the child's brain.
- A medical professional will decide whether the child's condition is stable or not based on the indications captured by this sensor.

All of the calculated acceleration and the EEG will be stocked in a smart watch to send it to a hospital database, as shown in Figure 4.

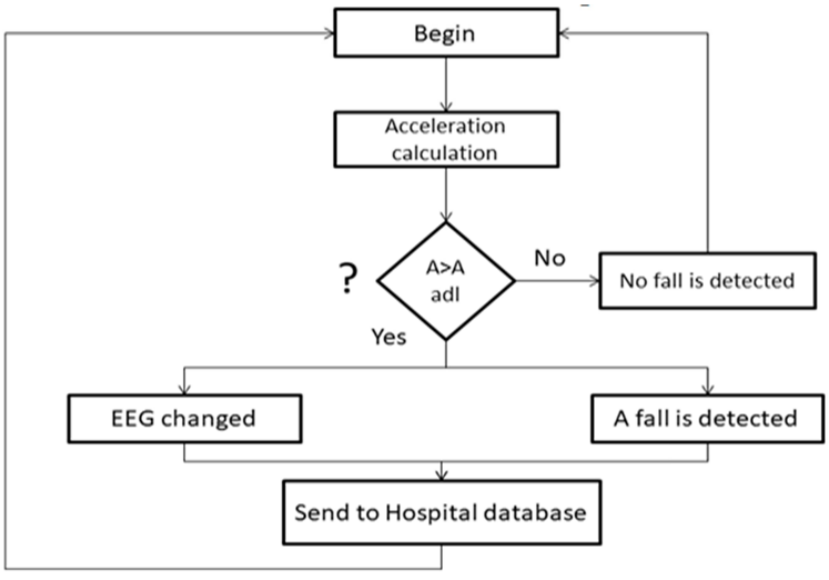

Figure.4: Diagram explains how data stocked in hospital database.

5.2. For Parents

This part describes the parents smart watch (See Figure 5).

- Smart watch that contains first aid application.
- The first aid application supports illustrated and audio instructions in case of accident.

Figure 5. Smart watch for parents

5.3. Scenario of Our Approach

In this part, we are going to explains how the prototype works in case of falling accident. We propose a global architecture encompassing the main actors involved in the monitoring and intervention of children (See Figure 6).

- A child was playing, crawling, setting down on a chair, suddenly he felt.
- The falling detector detected the fall by calculating the acceleration and it was bigger than the *A_adl* one.
- The calculations sent to the hospital database.
- An alert message sent to parents from the hospital.
- The parents go and interfere and do the necessary first aid.
- A medical professional monitor the child's brain condition after the EEG changed, and decide if the child's case is stable or not.

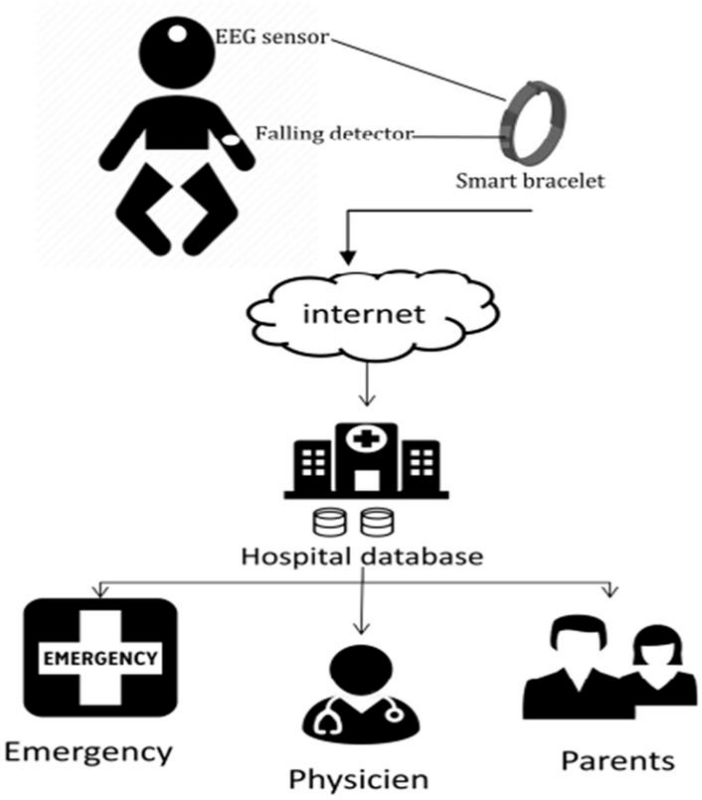

Figure 6. General Architecture of our approach.

6. DISCUSSION

The ideas of our approach was taken from the previous works that can help preventing falling disasters among the children.

From the first aid application to falling detector and EEG wearable devices .This prototype will help a lot of parents to prevent falling disaster for their children.

- It can reduce the pediatric fall disasters
- It will help parents to deal with such accidents, especially the parents who don't know how to act.
- It will speed up the intervention process.
- Yet, this doesn't deny that this prototype has some negative points:
- It supports only falling accident.
- It may send false alerts.
- Problem of flexibility since the two devices are wearable.
- Problem of privacy and security.
- Problem of battery life during day.

From the previous Table II, we can notice that our proposed prototype was inspired from work [7] because it's based on database, work [10] because it's a wearable devices and work [11] because it supports illustrated and audio advice for the first aid application for the parents.

Table II. Comparison between the previous works and our approach

Works	Accident type	application			Wearable device			Privacy	Database
		Works when Illustrated/voice :Online/offline instructions		*Based on cloud*	*Battery flexibility cost life*				
[5]	All types	This work is an intervention to prevent pediatric home accident							
[6]	All types	Online and offline	Illustrated instructions	x	x			✓ ✓	x
[7]	Pediatric intoxication	Online	x	Yes	x			✓	Yes
[9]	All types	Online and offline	None(only texts)	x	x			✓ ✓	x
[10]	Fall	x			✓	✓✓	✓✓✓	✓ ✓	Yes
[11]	All types	Online and offline	Illustrated and voices instructions	x	x			✓ ✓	x
Our approach	Fall	Online and offline	Illustrated and voiced instructions	x	✓✓	✓✓	✓✓✓	✓✓ ✓	Yes

7. CONCLUSION

We've seen from the head of this paper the definition of accident and home accident. Then we were in front of the importance of looking for a solution to prevent pediatric home accident. After, we've selected some works that deal with our problematic which is pediatric home accidents and made a comparison between them.

After that, we've proposed a prototype for pediatric fall from the previous works and works that were not mentioned in this paper. And finally, we've discussed about the positive and negative points of our prototype and we also compared this latter with the previous works.

With the technology advance, we hope that we can develop our idea so we can reduce the possible from negative points and rise the positive ones.

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