Asthma Triggered Alert System (ATAS) For Children Using Arduino Microcontroller

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***Abstract*— This paper presents a device that can detect one of the symptom of an asthma attack for children using Arduino Microcontroller and GSM SIM900. An asthma attack can be detected in many ways such as breathlessness, chest tightness, and cough, particularly at night or after exercise or after doing an activity. All of these symptoms cause the heart rate to increase rapidly. The objectives for this design is to detect the increasing of heart beat that will cause an asthma attack in children using sensor and it will sent an alert system to their parents for precautions. As for this project, a system being develop using pulse sensor to detect heart beat that will interface with Arduino Microcontroller then a messaging system will be sent to the parent using GSM SIM900 that will attach together with the system. This sensor is expected to sense heart beat and analyze into two types of asthma level in children.**

***Keywords*—Arduino Microcontroller, Pulse Sensor, Liquid Crystal Display (LCD), GSM SIM900, Interbeat Interval (IBI), Beat per minute (BPM).**

I. INTRODUCTION

Asthma is a condition where a person's airways are often inflamed or swollen, making breathing very difficult. Asthma is triggered by substances or events which cause a person's airways to become more inflamed or swollen than usual. This may cause a person to feel breathless, wheeze or cough that can increase a person's heart beat ratefl]. Asthma is medically defined as a chronic obstructive pulmonary disease, characterized by a hypersensitivity of the airways[l]. Nowadays, people only knows if a children is having an asthma attack after it become worse until sometimes it seems like the children can't breathed. With this device, parents can alert with their children's heart beat. An asthma attack can become more worse if there is no precautions taken at all and sometimes it can possibly cause a death[2]. Asthma in children has risen into 75% since 1982[3].

Prevalence of asthma among children has become an increasing problem in past few decades[4]. Asthma is the most common chronic disease among children[4][5]. In this case, we can said that certain hereditary and environmental risk factors can predispose a child to developing asthma. Cough is the common symptom of asthma and it can be the main symptom for children and most children with acute cough will cause an uncomplicated respiratory[6]. Cough However, the most common signs or symptoms that a children will face before they get an asthma attack is a rapid breathing in which also it can cause the shortness of breath or loss in breath[7]. This can lead to increases in heart rate of the children. More worse the patient can have peak expiratory flow rate (PEFR's) well into yellow zone and if it is not get any medication on that time, it will get the probability to death because of having a heavily breath[8]. Since changing in heart rate is one of the most important symptoms of an asthma attack[9], a fast and accurate devices detection of heart rate is needed. The significant of this project is to detect and read the heart beat rate of the children by using a detector called pulse sensor. This sensor is very unique since it is small and can be place on the finger or ear lobe. Thus it will not give the children feel uncomfortable by wearing this sensor. The focus of this project are the children whose ages are in between two to five years old. Normally a child in this range of age are at the nursery or pre-school where their parent are not around with them. So with this kind of device, their parent can get an alert anytime when their child is getting an asthma attack. Besides a child cannot take do any precautionary step on their own without the guidance from the parent.

A. Heart Rate

Heart rate is determined by the number of heartbeats per unit of time, typically expressed as beats per minute (BPM), it can vary with as the body's need for oxygen changes, such as during exercise or sleep[10]. Usually, the measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions.

People's heart rates vary considerably, depending on what they are doing, their levels of fitness, what medications they are on, and their age. There is a technical difference between heart rate and pulse. However the reading of heart rate and pulse rate should come up with the same number. A normal resting heart rate can range anywhere from 80 to 110 beats per

minute for children between 1 to 6 years old[11]. Below are the definitions for the heart rate and a pulse rate :

- Heart rate - how many times the heart beats in a unit of time, nearly always per minute. The number of contractions of the lower chambers of the heart[10].
- Pulse (pulse rate) - as the blood gushes through the artery from a heart beat, it creates a bulge in the artery. The rate at which the artery bulges can be measured by touching it with your fingers, as on the wrist or neck[10].

Generally, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness[12].

To measure a heart rate manually, it can be simply check your pulse by index and third fingers on your neck to the side of your windpipe. To check your pulse at your wrist, place two fingers between the bone and the tendon over your radial artery which is located on the thumb side of your wrist.

So, a device that can sense the heart beat will be place to children and their parents can have an alert through messaging if their children's heart beat increased rapidly than a normal person heart beat rate and this will prevent cases of unattended asthma attack in children.

Thus, objective of this project is to detect the abnormalities in increasing of the heart beat rate in children that can lead to an asthma attack and the alert signal will be sent through messaging to the parents or maybe direct to the personel doctor of the children.

This paper will concentrate on reading the children's heart beat rate and sense an abnormalities or increasing rapidly in heart beat by using pulse sensor interfacing with Arduino Microcontroller and connected together with the GSM SIM900 to send an alert system via messaging.

II. METHODOLOGY

For this design, the device is developed to detect abnormalities of heart rate in specific for a children age between 2 to 5 years old. The abnormalities are varied and divided into two categories as presented in the table below.

Two categories of detection in abnormalities of heart rate as follows:

Types of asthma	Beats per minute, bpm
Moderate asthma exacerbation	125 - 140
Acute severe asthma	>140

Table 1: Asthma detection categories

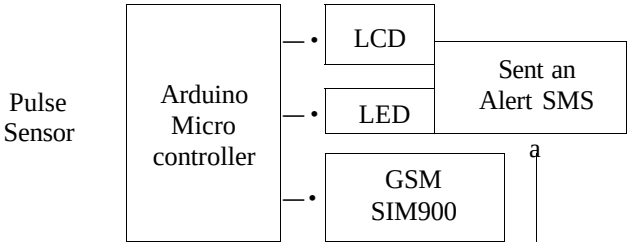

Figure 1: Block Diagram

As shown in the block diagram, there is one input interfacing with Arduino Microcontroller that will be processed based on the coding and it will produce three outputs. In this project pulse sensor will acts as input that will read heart beat of the children and at the same time, LED will lit as the sensor reading the heart beat and the LCD will display the heart beat (BPM) of the children. The third output which is GSM SIM900 will only sent an SMS alert if the sensor senses an increasing of the heart rate (BPM) as stated in the Table 1.

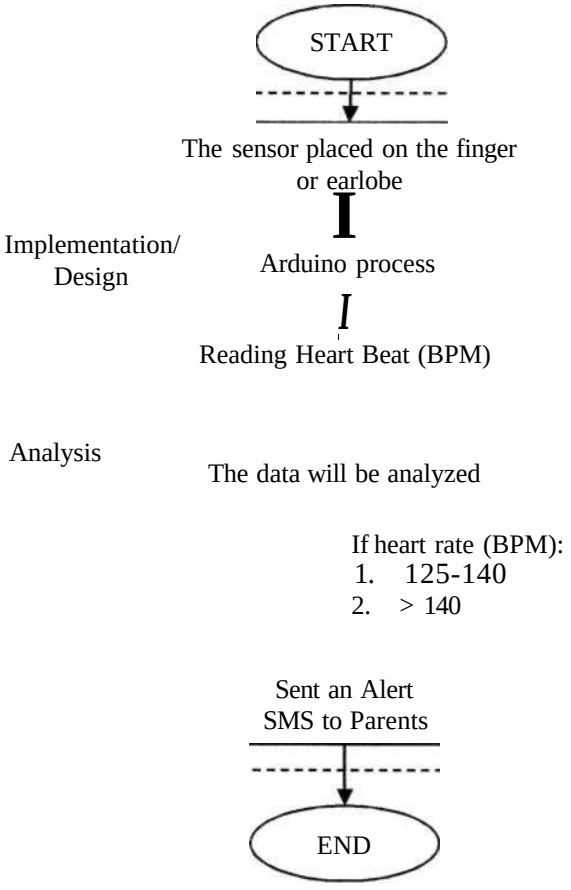

Figure 2: Flowchart of the System Design

firstly, the pulse sensor must be put at a sensitive place on the body either finger or earlobe so that the sensor will be more effective when its read the heart rate as input. The sensor is very small enough to put it on a finger or at earlobe using clipped given.

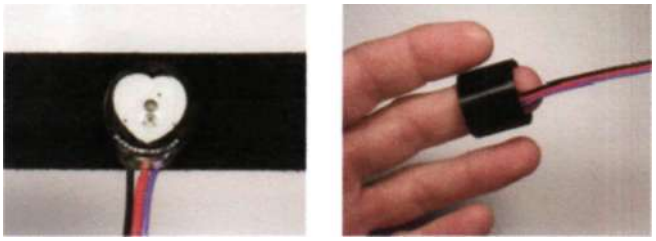

Figure 3: Pulse sensor on a finger

Figure 4: Pulse sensor with clip for putting it at earlobe

After putting the sensor properly, the sensor will start reading the heart rate in beats per minute (BPM). At the same time, there is an LED that will lit every time the heart beat sense by the sensor and also the reading of heart beat will be display on the LCD that attach with the system. The microcontroller will always analyzed the heart beat reading until there is an increasing of heart beat rapidly, the GSM SIM900 will automatically sent an SMS alert to the parent which tell them the reading of their children's heart beat and types of asthma that their children having at the moment they receive the SMS.

III. RESULT AND DISCUSSION

When this device is in 'ON' condition, LCD will display as 'ATASDevice' to show that the device is ready for use to take the reading of heart beat rate.

Figure 5: Starting Display

As the sensor have been put on the finger, the sensor started to read the heart beat rate. The result was taken at random time so the heart beat rate of that children shows different reading in a range of 80 - 110 beat per minute(BPM). This reading of heart beat rate was normal for children age between 1 to 6 years old. Below is the image of sample result taken for heart beat reading of a children :

Figure 6: Image of Heart Beat Reading 1

Figure 7: Image of Heart Beat Reading 2

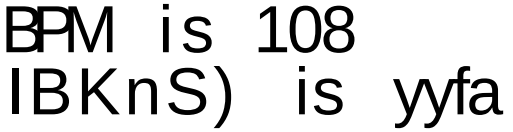

Figure 8: Image of Heart Beat Reading 3

This result had been captured during the sensor reading the heart beat rate of the children without any symptom that can trigger the children to have an increasing of heart rate rapidly.

The reading of heart beat rate once again being taken at the moment that children having a heavily breathtaking, the result of the reading heart beat rate as shown below. It shows that the children have an increasing of heart beat rapidly from normal resting heart rate to 134bpm. This shows that the children having a moderate asthma exacerbation since the range of this type of asthma is from 125bpm to 140bpm.

Figure 9: Image of Heart Beat Reading 4

At the same time, an alert signal had been sent through SMS by GSM SIM900 to tell the parent that their children is having an asthma attack.

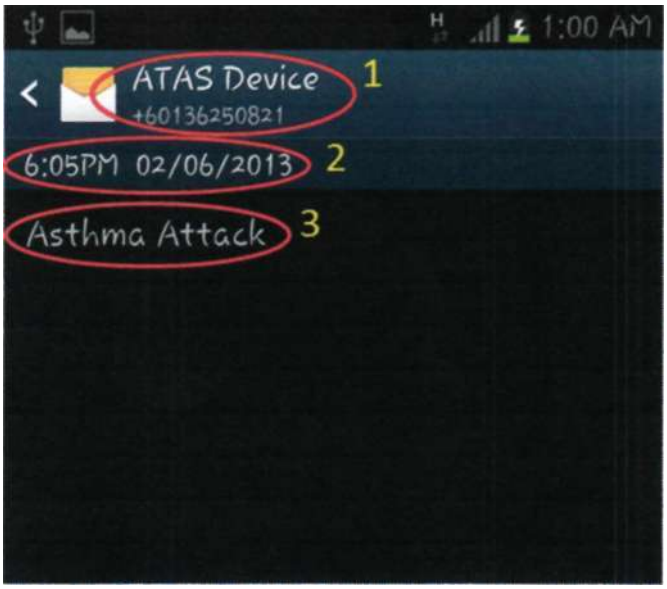

Figure 10: Alert SMS sent by GSM SIM900

LEGEND	DESCRIPTION
	Number of GSM SIM900 saved as 'AT AS Device' in the parent's phone
	The time and date of the message received from AT AS Device
	Alert SMS from the device texting as 'Asthma Attack'

A child's heart rate is increasing rapidly from a normal resting heart rate until 134bpm because of at that moment, the child is actually having a heavily breathtaking. The reason for the increasing heart rate because one of the asthma symptoms have been triggered to make that child having an asthma attack. After analysing what the child done before that, the possible symptom that cause an asthma attack in that child is food allergies. The child is having a cake which definitely contains an egg as the ingredient. As stated in the literature review, the egg is one of the allergic symptoms that can trigger asthma in children.

For this project, the device may not good enough in the sensitivity when comes to the part of reading heart rate. Sometimes the sensor sense the child's heart rate wrongly because the movement of that child. We cannot and impossible for us to control the child's movement because of their age, the children are very active. This will cause the sensor a problem in reading the heart rate of the child and in order to get the accurate reading. This problem also occurs when the first reading of heart rate being taken from the sensor. Sometimes it will start with higher reading of heart rate such as 150bpm and above or it can also be lower as 40 and below.

IV. CONCLUSION

In this paper, a simple device to detect an increasing of heart beat rate in children using microcontroller have been developed and it had been tested already. The main objective of this paper had achieved since it can detect and read the heart beat rate through a pulse sensor interfacing with Arduino Microcontroller. The normal reading of children's heart beat rate fulfill the range of normal rest heart beat rate for children which is in between 80bpm to HObpm. Whenever the heart beat rate is increase rapidly exceeding the range of normal heart beat, an alert signal have been sent through SMS to the parent of the children. Based on the tested device and the results, it is found that the proposed of Asthma Trigger Alert System is successfully meet the objectives of this paper.

For the future recommendation, this device can be upgraded into a portable sensor device which is the pulse sensor should be a wireless pulse sensor. So that this sensor will sent the signal of heart rate to the arduino processing via transmitter connected with the pulse sensor and the processing will be received the signal through the receiver which is pairing with the transmitter itself.

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