Asthma Monitoring And Analyzer Band

Asthma: Factors And Issues

Introduction:

Asthma is a common respiratory disease in children, which can be defined as the long-term lung inflammatory disease which affects the children. For children with Asthma, airways of the lungs get narrowed and excess production of mucus in the bronchi, causes difficulty in breathing. The causes of Asthma can be due to allergy, genetic disorder, or due to sensitive airways [1]. Generally, asthma is a non- curable disease, but with proper medication, the effects can be controlled. As Engineering students, we would like to innovate devices which could assist the patients in the medical field. Innovation in medical equipment is far more complex compared to innovation in other technologies. This is because, the medical devices have a great responsibility of handling the lives of the patients and the accuracy of the results plays a major role in this domain. The purpose of this report is to introduce a novel approach for aiding the children affected with Asthma. We have deigned a wristband with a wearable mount which could detect the location of the patient and send it to the medical center. This wristband's unique design is that it alerts the patient as well as the caretaker of the child about the environment which could induce asthma in the child. The GSM present in the wearable mount informs the child's parent when the child is attacked by asthma. The material used for the wristband is non-toxic and water-resistant. As this band is mainly for children, it comes with a customizable feature of different colors and cartoons on the strap. The device is designed to operate in low power conditions where the sensors in the circuit are operated at 0.1 to 1mw. The heartbeat is measured through photoplethysmography and electrocardiography, whereas the respiratory measurements are done through photoplethysmography [2]. The readings of the patient are compared to a database value which is stored in the memory of the device. The stored vales are the threshold level, below which the patient would be prone to an asthma attack. Thus, if the readings of the patient go below the threshold level, the child will be facing an asthma attack, and the health report of the child along with location is sent to the nearest medical center. The pollution detector present in the device is responsible for detecting the pollution and irritants that could induce an asthma attack to the child. If the pollution level is higher then, the chip will induce a pulse to the beeping circuit which alarms and informs the parent or the caretaker to take the child away from that environment.

Design Description:

Asthma monitoring and analyzer band is a wearable device which looks like a watch. It monitors the air quality around. When it detects the bacteria, bacteria-like organisms, fungi and viruses in the air is above some set-up level, it will beep and warn the people to let the children get away from the pollution. It also can be developed under Android and Google API to further functions such as GPS signal sending, emergency contact and more.

It has four parts: pollution detecting part, wearable mount, power system and sound system.

Hardware Chipsets and Detectors:

Some of the Chipsets such as ESP32 can be used to programmed and work under Android system. Pollution detecting part also can be found in the market. This part is to have reactions to the pollution in the air and generate several responding signals to the Sound System to trigger a beeping sound alarm.

Wearable Mount:

Wearable mount is the part that allows the customers to mount the system parts on the clothes or bags. The whole system will not be larger than a key fob so it can mount on the clothes to make the system wearable.

Power system:

Power system is the part which provides the power to the system. It is rechargeable and well-isolated. It will be fully covered so it can bear water or other outside impacts. It also can last for several weeks before asking for recharging. Apple Watch Battery

Sound system:

Sound system is the part which can alarm the customer. It receives the signal which is generated by the pollution detecting part and then beeps loudly. It also can beep differently to different kinds of signals to remind people of several conditions.

Computer based tools:

There are several tools we can program the chipsets of the band. Android Developer, Python, Ruby, C++ and a lot of developing tools can be used to program the chipsets. It can then have extension functions as it is can be open for programming. It can contain Wi-Fi function (based on ESP32 Chipsets [4]), GPS function (based on Android Google API [5]), timer, emergency contact and others due to it is an open source for programming. Customers can DIY(Do it Yourself) their functions and pick what they want, and we can provide further software upgrade in the future. Some streaming functions can also be added, and the customers can choose different providers to become their members depending on different requirements of services.

Technological issues:

The wrist band operates using lithium-ion batteries which provides the best performance compared to other kind of batteries. They are less in weight and charges more efficiently [6]. But the disposal of these batteries is a major environmental factor to be considered. Thus, we have decided to hold the membership of each patient, where they could replace the battery once if it is dead and we take the responsibility of recycling the battery. Some other technical issues we would face in designing the wristband is the size of the pollution detection circuit and the technical issues like heating up of the circuit which would lead to malfunction of the thermal sensors and thereby leading to false detection. As we have implemented GSM technology to inform the status of the patient, network connectivity also plays a major role in proper function.

Social issues:

According to “Australian Bureau of Statistics 2018; National Health Survey: First Results 2017-18” one out of every nine Australians are affected with asthma. Focusing on Australia, this innovation could decrease the risk factor faced by the Asthma patients [7]. But initially, the child as well as the parent should adapt to this device. The parent should be cautious about the messages received from the wristband stating the health status of the child. As Children spend most of their time in school, the teacher or the caretaker has more responsibility in understanding the functioning of the wristband and should know the medication procedures to be followed if the device detects the occurrence of asthma attack. The medical centers should also work equally with the device, as we set a threshold value of the respiratory rate. If the child is facing severe asthma attack, the devices, directly sends the patients current report to the medical center along with the location.

Environmental Factors:

This device will be used by children therefore it will have to work properly in water, dust and at all levels of temperatures. For making the device water resistant we will use the method of nanocoating. This method infiltrates the device and makes it water resistant [8]. The slot available for charging can also become a path for the water to enter, for this we will use small O type rings which will be placed inside the device and attached firmly to the inside surface. This will not let the water enter the device [9].

The band for the device will be made of thermoplastic. Thermoplastic is mainly used in making of toys for children, chew toys for dogs, balls for children etc. It is a polymer which is very pliable and can be used in a wide variety of products. It is non-toxic which makes it safe for children. Thermoplastic can sustain in any levels of temperatures; it is water resistant and because of its high tensile strength it will not tear or break apart [10]. As the band will be made from thermoplastic, if it gets dirty, it is washable and hence can be reused for a long period of time. Hence it is cost efficient and environment friendly to some extent.

IP Issues:

When any individual or a company develops a new device or technology, intellectual property (IP) issues should be always taken into consideration. The development process, raising capital and many other issues might feel more significant but the intellectual property is the most significant important asset of the company [11].

IP is essentially protecting an innovation, ideas, trademark or designs from other competitors. There are different procedures to apply for an IP some may require a formal application where your product or idea will be examined, if everything is approved you can claim a right to ownership, other IPs may not require such kind of procedure.

A patent is a right that is conceded for any gadget, technique or procedure that is innovative and valuable. After acquiring a patent for a product, you have the rights for its ownership until the life of the patent [12].

The types of patents available in Australia are of two types. One is the standard patent and other is an innovative patent. The life of the standard patent is up to 20 years from the date of filing the patent. This patent is mostly for an innovation which has a long market life.

Our device is not a not a completely new groundbreaking invention, it is a combination or changes made to already existing devices. There will be upgraded versions of our device in the market in terms of technology or other aspects in the future. Hence the patent we will be needing should not be for a long term. Therefore, the patent suitable for our device is the innovation patent. The life of this patent is up to 8 years. It is considerably cheap, easy and there are no examinations performed therefore the patent is granted within a month of its application [13].

R&D Issues

Research and development are an important part of technology and innovation, R&D Provides the funding to many organizations for the development of innovative technology. The Australian government spends around $10 billion every year on research and development. [14] Australian Government research organizations are the National Health and Medical Research Council (NHMRC) and Australian Research Council (ARC) Which provides Funding to Medical Technology. [15] The money is spent on the National Health and Medical Council, Australian research council, medical research future funds and many other areas. [16] The Asthma monitoring and analyzer band is the type of medical technology device and the government uses an inherent portion of investment in Medical research future, National Health and Medical Research Council (NHMRC). Therefore, the Asthma monitoring and analyzer band can use the R&D funding to develop the whole design for medical usage.

Legal issues

Legal issues are important, if a device has side effects or any risk factors, it can have bad impression towards the user. The Asthma monitoring and analyzer band has no side effects as it is non-invasive i.e. the patient does not have to inject it inside the body in any form, hence it has minimum risk towards the patient [17]. It’s just a device which identifies the surrounding environment with help of sensor and sends the message to the child’s parents through GSM, So it can be used without considering any risk factor.

Regulatory issues

Regulatory issues are also important in Australia, TGA (Therapeutic Goods Administration) is the organization which regulates Medical devices and other medical products. There are some essential principles which are implemented on every medical technology device to get that device or technology approved by TGA (Therapeutic Goods Administration) [18].

The Principles are:

- Safety requirements
- Properties like chemical, physical, biological the device should possess.
- The information should be listed on the device
- There should not be any side effects or Infection and microbial contamination. [19]

The Asthma monitoring and analyzer band do not have any safety issues. It doesn’t have any side effects of infections and microbial contamination. Once the device is approved by TGA then it can be used for treatment or monitoring purpose.

Conclusion:

As asthma is an incurable disease, we must concentrate on handling its symptoms and effects better rather than trying to eliminate them. The pollution in the air is increasing because of increase in toxic gases emitted from the vehicles, machines and factories. As discussed in our earlier report pollution is one of the main problems which triggers children with asthma. Our device detects the pollution in air and warns the child’s parents, guardians or teachers when the level of toxic gases in the air are high. With the help of this device parents can take action to leave that area before the pollution can affect the child. If in case the child is affected and need medical attention , a message will be sent to the parents and a medical facility who would be able to take immediate action and help the child. The band for the device is made out of thermoplastic and hence it is water resistant, temperature resistant and reusable[10].Our device is easy to use, environment friendly , non-invasive and has no side effects ,thus it a good solution to monitor and control asthma in children.