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ISBN-13: 979-8706808556

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Intelligent Suit for Monitoring and Controlling Heatstroke (iSuit)

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***Abstract*—Workplace temperature has always being high for workers working in brick kilns, furnaces, construction sites, engine rooms in ships etc. Also it is continuously rising due to climate change which results in health problems, low productivity and loss of working hours. To tackle this problem we have designed this thermal Intelligent Suit "iSuit". This iSuit has an internal cooling unit and it also has an array of sensors to show the vitals of bio information of the personnel wearing it. The iSuit has wide range of features including suit as well as surrounding temperature, humidity, pulse, altitude from sea level, pressure, dew point. Our iSuit is Wi-Fi controlled along with a mobile app 'iSuit Monitor' to view sensor information and status. This is a life -saving device as it can prevent heat stroke depending on the environmental conditions.**

Keywords—application, coolant, condition-monitoring, Wi-Fi

I. INTRODUCTION

In India working temperature can be as high as 60º C. According to International Labour Organisation, rising temperature at workplace can cost about 80 millions jobs worldwide, India will suffer the most."India is in absolute terms expected to lose the equivalent of 34 million full-time jobs in 2030 as a result of heat stress". (Working on a warmer planet, ILO 2019)

High temperature at the workplace is a serious nuisance faced by workers around the globe. The Body can work well with temperature ranging from 20-27 ºC with 50-60 percent humidity, but when it rises the body tries to adjust itself to cope up with. The Human body maintains its body temperature at 37º C, change of more than one degree usually occurs in illness or in adverse environmental condition. To cope up with that body's thermostat increase the flow of blood and hence body sweats. Evaporation of sweat causes a cooling effect and hence body temperature comes back to normal. So in this way the body eliminates heat to get rid of excess heat burden.

When working temperature increase from the range of comfort various problems can arise. Firstly it will affect the way you feel, increase irritability, loss of concentration and decrease in the productivity. Some research also signifies that prolong exposure to heat can affect your kidneys, liver and heart also.

Much illness occurs due to high temperature which ranges from heat cramps, rash and to fatal strokes. We have mentioned few below:

1.1 Heat stroke:

Heatstroke is a condition caused by your body overheating, usually as a result of prolonged exposure to or physical exertion in high temperatures. This is most serious form of heat injury, heatstroke, can occur if your body temperature rises to 104 F (40 C) or higher. Heatstroke requires emergency treatment. Untreated heatstroke can quickly damage your brain, heart, kidneys and muscles. The damage worsens the longer treatment is delayed, increasing your risk of serious complications or death.Every year many people die due to this and this medical condition becomes serious on places like construction sites ,ships etc because of lack of medical personals.

1.2 Heat stress:

It is also one of the problems faced by workers, heat stress affects the working efficiency by reducing their capability to think, work and make crucial decisions.
Heat stress occurs when the body cannot get rid of excess heat. Lack of precipitation doesn't allow sweat to evaporate and thus makes situations even worse. Factors that contribute to heat stress are high air temperatures,

radiant heat sources, high humidity, direct physical contact with hot objects, and strenuous physical activities.

These can be avoided by wearing the iSuit in such conditions. It's completely versatile as it can be worn inside shirts and office suits apart from boiler suit (overalls).iSuit in case of extreme hot condition zones brings down the temperature maintaining body level optimal functional temperature reviving the personnel wearing it. Once the temperature rises as in case of hot environment like the engine room, iSuit starts its cooling automatically, by circulating the cooling element throughout the hotspots, bringing down the body temperature to functional limits providing comfort and life saving aids to the personnel wearing it. As the temperature rises, alarm on the suit goes off indicating rise in temperature and cooling starts automatically bringing down the temperature. The temperature, pulse, humidity, altitude, location, dew point records are sent to the mobile app and constant monitoring enables to prevent incidents beforehand. iSuit also has an LCD display embedded on itself showing the Name, Blood group, temperature, pulse and location of the personnel wearing it.

If the temperature goes high or low beyond levels or if pulse drops down, immediately the alarm on the iSuit goes off indicating life support conditions and thereby reviving the personnel as early as possible. Constant logs are kept in case of extreme condition that helps in investigations carried out in the aftermath of an incident. The iSuit is useful for both workers as well as regular engineers depending upon the structural changes.

Fig: ISuit

II. WORKING

2.1 Mechanical Setup

Things required are as follows:-

1. Two DC water pumps 12 Volts supply
2. 12V Li ion battery
3. One adiabatic container with water permeable membrane on one side
4. Dry ice/normal ice depends on availability
5. Cooling fluid like water
6. Pipes
7. Heat sink
8. Two DC fans
9. Solenoid valve

2.2 Mechanism

This device works on same principle as engine jacket water cooling system (where body is like engine to be cooled). Here we have one cooling unit, heat absorbing unit and one pumping unit. Heat absorbing unit consists of pipelines of Conductive Fiber spread all over the body inside jacket system (material of pipes is conducting type), these pipes carry coolant fluid which is pumped throughout with the help of pumps.The cooling unit consist a Insulated Box that has a mixer of Dry Ice and Ethylene Glycol. When the iSuit is activated, the water, after absorbing heat it is cooled at cooling unit and then again circulated in loop. Cooling unit extracts heat from cooling media with the help of heat exchanger or direct cooling based on direct contact type. This heat is eliminated from apparatus with the help of permeable membrane which allow droplets of water to pass and gets cool with the help Dry Ice.

The Insulated Box willsustains temperature of cooling medium which allows dry ice to be there for extended period.

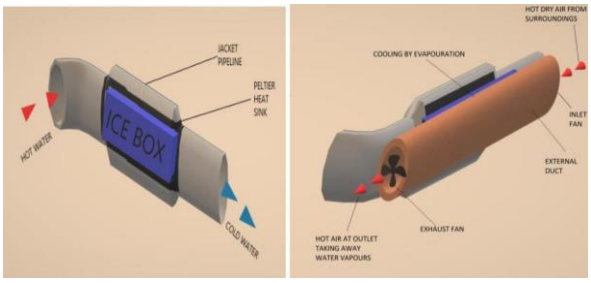

Fig: Working

2.3 Electronics

1. Temperature sensor
2. Pulse and heartbeat sensor
3. Altitude sensor BMP
4. Alarm or buzzer
5. Wi-Fi Module
6. Display LCD

Two temperature sensors are involved in measuring temperature of circulating medium as well as of the surrounding. Whenever temperature of circulating medium is above predetermined value, it activates pumping unit from standby condition to working and once temperature of medium is brought down to predetermined value it again comes back to standby condition to save power. All these temperature data is feed in micro-controller which gives command to pumps. Solenoid valve provided isolates cooling media from cooling unit whenever required. When whole of cooling element is consumed, micro-controller actuates and alarm to recharge cooling element with new. And ice is installed again by opening cartridge. Pulse and heartbeat sensor are provided in case the person is in danger and his/her pulse drops or shoot too much away from predetermined value, it actuates an alarm and also sends signal to control room officer via wireless signals. These signals contain data of name, position of that person, deck level, and real-time microphone recordings. Immediate help can be provided to that person without any misguidance. Additional emergency button is also provided on suit which sends same data in case person senses some danger nearby. All these data are also displayed on display provided on iSuit.

III. APPLICATIONS

The iSuit is an ultralow-cost life saving device and this can be affordable by all types of personnel and engineers. This effective innovation can be used in a variety of fields in which there is a exposure of high temperature like blast furnace, coal mines, boiler room, engine room etc. This suit will actually maintain their body temperature and increase their efficiency and reduce health problems related to heat, thus reducing the expense and insurance related to health and save a ton of time and money for the individual as well as the company. As according to our innovative prototype this cost around 1200 INR in total and the market price of a completely factory-made product will be even lower below 1000 INR. This negligible investment will yield a long term benefit. This can improve the employment opportunity of the fields where people fear to work due to high temperature. As iSuit is completely Wi-Fi controlled, there are very less instances of signal failure which won't affect the functioning of devices as it performs autonomously without connectivity too.

Fig. Mobile Application Screen

IV. CONCLUSION

The iSuit is an innovative ultra low cost life saving suit that is versatile along many areas of workplace and essential for saving life in extreme conditions also providing comfort for personnel enabling more productivity and efficiency in terms of work performed.

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