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Survey on Child Safety Wearable Device Using IoT Sensors and Cloud Computing

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Abstract:- Child safety is a major concern in any society due to the vulnerability of a child and consequently, higher rates of crimes against children. With this issue on our hands, a smart wearable Internet of Things sensor network for monitoring the environment of a child can be developed to help parents ensure the safety of their children. It must also necessarily include a mechanism for tracking the child. An advantage of this wearable device is that, according to its design, it can be accessed from any mobile device and does not mandate a lot of technical knowledge from the user to operate. The purpose of this device is to facilitate the guardian or parents in locating their child with ease and ensuring its well-being. The basic mechanism of this system involves monitoring the environment through sensor nodes, acquiring real-time data and transmitting this data to a cloud server. The data can be accessed by users through a web-based interface present on this cloud server. The wearable also functions to send alerts to the user through a mobile application in case an emergency condition is detected by it. The design of this model involves developing a medium for communication between the parent/guardian and the child's wearable device. The child's location is tracked using GSM mobile communication to specify the location of the child in real-time. We have surveyed relevant papers and have discussed about the different methodologies that have been used to achieve similar but different results. We later also compare these papers using their advantages and disadvantages and we try to bring out the uses from their results.

***Keywords*:-** *Child Safety, wearable devices, Internet of Things, sensors, IoT sensors, Wearable IoT sensors, GPRS, sensor network, safety application, Arduino, GPS, GSM, Thing Speak, microcontroller, Temperature sensor, UV sensor, Cloud application, Cloud Computing.*

I. INTRODUCTION

[1] Shows a savvy IoT gadget proposed for youngster security and following, created to assist guardians with observing and find their kids. This framework is constructed utilizing LinkIt ONE board that is encoded in implanted C language and is likewise interfaced with different sensors, an advanced camera, GSM and GPS functionalities. The framework is intended to consequently alarm the watchman/parent by sending SMS when quick consideration is required during a crisis. [2] Gives a demonstration of the ChildGuard system that tracks the movement of unsupervised children in real-time using mobile devices. Notifications in the form of alarms and reminders are sent to the child, and the guardians are alerted of abnormalities in the child's daily routine. ChildGuard operates as a security method for monitoring children by using emergent technologies like wearable devices or simple smartphones. These high performance devices keep track of the child's movements and whereabouts, and proactively keep the parents/guardians informed about any possible safety threats or risks.

[3] Presents a model of a light-weight, configurable, smaller and low force utilization wearable gadget to watch ecological/surrounding conditions. It presents this gadget in five physical layers. The model uses a multi-layer and multi-sensor approach and can quantify an assortment of risky gases, gives movement following and checks physical encompassing parameters.

[4] Presents a wearable IoT sensor system to regulate destructive natural conditions using a Lora wireless network for safety applications. Hazardous ambient or environmental conditions can cause critical health problems for people working in harmful/toxic conditions. The sensor hub screens constant ecological information and sends it to a cloud server. Clients can see this information over a web application on the cloud server. The wearable device also notifies the user of an emergency situation that is detected, by a mobile application as well.

[5] Demonstrates a Smart Wearable Armband for stroke survivors. The recuperation of upper appendage engine usefulness for a Stroke survivor is nearly increasingly slow troublesome than their lower furthest points, and the degree of hand work recuperation is frequently restricted. Conventional therapy may not always work, requiring the patients to undergo one-on-one interaction with a physiotherapist, and remain motivated to recover.

[6] Demonstrates the algorithms that are used for detection purposes based on wearable sensors for fall detection. This is a logical issue and a badly characterized process which can be explained. Since elderly people are more prone to dangerous events like falling, it tends to be exceptionally valuable to build a fall identification framework for patients who might be oblivious or unfit to call for help in the wake of tumbling down. In this way, this framework can be significant to the development of an IOT stage in the clinical field.

[7] Discusses the statistics of vehicle accidents caused by heavy traffic that lead to many injuries and deaths around the globe. This portrays the usage of a Laziness Weariness Recognition Framework dependent on Wearable Brilliant Glasses to Expand Street Security. It also provides The National Highway Traffic Safety Administration (NHTSA) stating the rapid increase in the number of vehicles that has led to an increase in the number of accidents. The World Health Organization(WHO) anticipated that street traffic wounds would turn into the fifth-driving reason for death by 2030.

[8] Proposes an UV Light Sensor Test that depends on Polymer Covered Optical Fiber that is photo-responsive. Ultraviolet is an electromagnetic radiation with a wavelength of 10nm to 400nm that can be generated due to lightning strikes and high power output. A decentralized UV detecting fiber optic test joined with photochemical polymer, covered with azobenzene is utilized to gauge UV-induced strain on the optical fiber.

[9] Proposes a Ultrasensitive Temperature Sensor with Fell Fiber Optic Fabry–Perot Interferometers dependent on Vernier Impact. Temperature is a physical parameter that is most every now and again estimated as it is constantly identified with human action. The demands of temperature sensors have increased in the fields of biochemical engineering, medicine and so on. The temperature sensor proposed uses Vernier effect combined with cavity media to produce ultra high temperature sensing and amplification. The proposed sensor is minimized in configuration, requires simple manufacture, is savvy and can be bundled as a minor test for remote detecting. Papers [10][11][12] are very similar, yet the objectives and methodologies differ greatly.

[10] Demonstrates about a wearable device for tracking and monitoring the safety of child and discusses about how this safety device could help children getting lost or going missing in crowded areas, which is the motivation to develop this device .This safety device could be operated on any cell phone since it uses SMS messages and has lesser frequency of failing when compared to Wi-Fi or Bluetooth . Hence it does not require the parents or guardians to have a smartphone. Guardians can send messages with explicit words, for example, 'area' or 'temperature' to the gadget and the gadget in turn answers with a message containing the exact location and the surrounding temperature of the child.

[11] Discusses about Child safety and how it has become a major concern in today's society, as many children are reported missing and complaints are left unattended. So this paper demonstrates the objective of providing safety for children against threats and provides a safety device that focuses on the children's temperature and heartbeat, in turn giving a correspondence medium between the youngster and the parent. It also uses a GSM and GPS for data transmitting and to send the exact location the child is at as messages to the parents. This paper provides only with the temperature and heartbeat measurements along with the location of the child compared to [10], which also provides these measurements along with an SOS light and alarm. [12] Focuses on providing a safety wearable device for little children to help track their location and temperature using components like GPS and GSM, by the parents. This device uses an SMS as the communication medium. The motivation to develop this device was to secure the safety of little children that could get lost or go missing in crowded areas.

II. METHODOLOGY

The methodology used in [1] is demonstrated in the following Block Diagram:

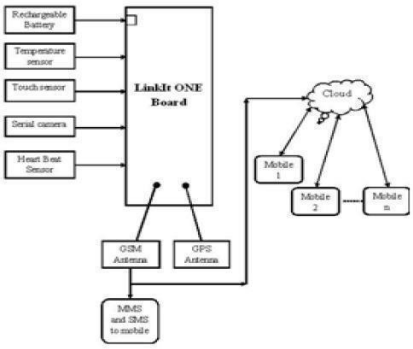

Fig 1

The above Figure 1 speaks to a square graph of the youngster wellbeing gadget proposed in the paper. The LinkIt ONE board is an open source stage. It comprises of inbuilt Wi-Fi, GSM, GPS and Bluetooth modules. Different components such as Temperature sensor, Touch sensor, heartbeat sensor, GSM, GPS modules and serial camera are connected to the LinkIt ONE Board along with built-in GSM, GPS modules.

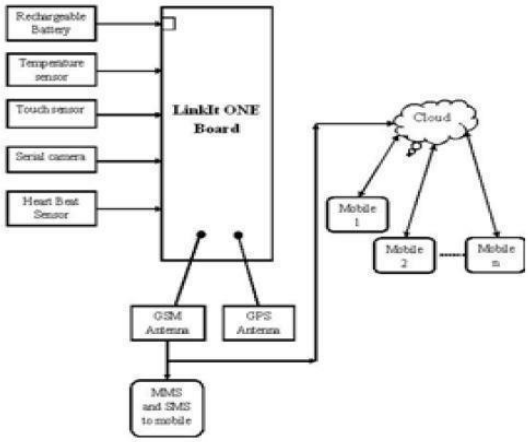

Fig 2

The block diagram of the proposed youngster wellbeing gadget is shown in Figure 1. The LinkIt ONE board is an open source stage. It comprises of inbuilt Wi-Fi,

GSM, GPS and Bluetooth modules. Different components such as Temperature sensor, Touch sensor, heartbeat sensor, GSM, GPS modules and serial camera are connected to the LinkIt ONE Board along with built-in GSM, GPS modules.

For every 30 minutes except serial camera, the data from GPS, temperature, touch, and pulse rate data is pushed into the cloud. If the values read by the sensor pass a threshold value then an SMS alert is sent to the mobile. The child's parameters of touch, temperature & heartbeat can be plotted on a graph and used for parametric analysis. This is shown in the circuit diagram below:

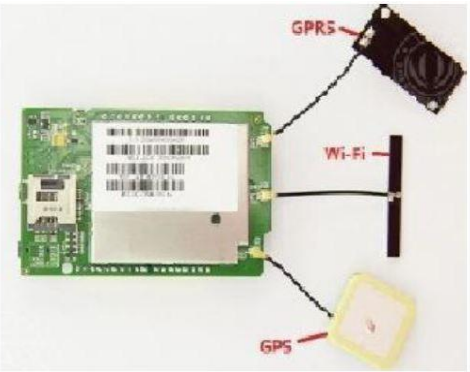

Fig 3

The kid protect framework in [2] is organized into three sections and two principle capacities. The unmistakable parts are; a gatekeeper application (which shows up on watchmen's cell phone), an application for the youngster (which shows up on the kid's cell phone) and a web server. The two fundamental techniques for guarding the kid are region safety and in-path safety:
-In-path safety is used when a child goes out alone. This system collects the child's real-time geographical coordinates and sends them to the guardian's mobile. It likewise shows the kid's continuous developments on the guide.

Region safety alarms the guardian if the youngster moves past a specific locale. The kid will be advised to come back to the assigned territory. Other regular capacities implemented in both mobile devices are communication, positioning and line drawing, voice reminders and alerts. The architecture used here is shown below:

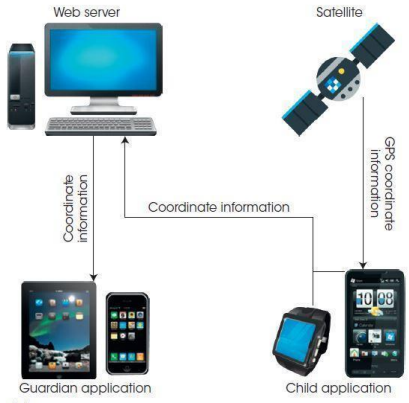

Fig 4

In structuring the proposed gadget in [3], three sorts of parameters are assessed during the estimations:

- ambient physical parameter including sound level, gaseous tension, stickiness, and temperature
- chemical encompassing parameters, for example, subjective and quantitative location of CO, SO2 and NO2 gases
- motion following for day by day exercises to interestingly distinguish each spot air quality.

In this approach each layer performs a specific task and they are:

- Host platform – It is the main off rack physical layer. It is fit for stretching out in the two headings of Z-pivot.
- Gas sensor hub – The significant worry of this layer is to distinguish unsafe/poisonous gas.- Notification system – It is used for warning individuals about an abnormal status.
- Equipment flex interface – This layer encourages show and sound module association with the host stage.
- Battery and holder – It is the last layer and is bound to the host stage and holds battery encompassing it.

The idea, criteria and prerequisites of the proposed wearable are connected to the equipment interface and are incorporated to use the correspondence convention. This is shown in the block diagram below:

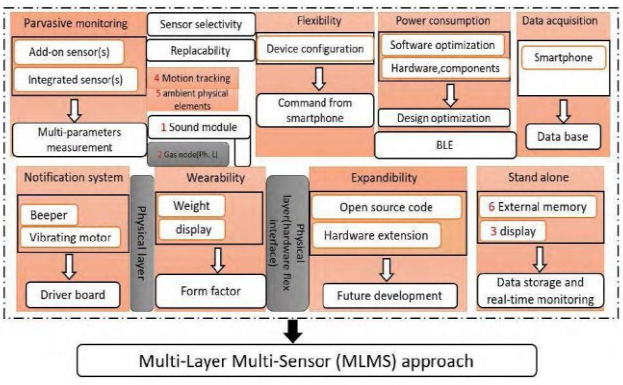

Fig 5

[4] utilizes an arrangement of a self-fueled wearable IoT sensor organize, named WE-Safe IoT venture, for wellbeing ecological observing. Every sensor hub comprises of a miniaturized scale power director, a detecting unit, and a remote module. The smaller scale power director is intended to collect vitality both inside and outside to empower a ceaseless vitality supply for the sensor hub, which is low-power consuming. The small scale controller gathers information from the sensors and interfaces with the LoRa chip. There is a temperature and mugginess sensor, a CO2 sensor and an UV sensor. The information gathered is transmitted remotely utilizing long-go LoRa remote innovation. It gives a long range, low power and ease answer for the wearable system. The system graph of the proposed wearable sensor organize is demonstrated as follows:

Fig 6

[5] demonstrates a prototype that has two parts: the smart wearable armband (SWA) part and the smart training equipment (STE) part. The Armband is made up channels, a front-end, remote module and material anodes which collectively perform the functions of collecting, pre-processing, and wirelessly transmitting bio-potential signs from the forearm. The SWA can be worn around the client's lower arm and give solace and non-abrasiveness. Material cathodes and stretchable material were utilized to create this armband. The STE for the most part comprises of AI calculations and a 3D printed apt robot hand. To start with, the remote module gets pre-prepared sEMG signals from armband and transmits them to PC have. In the PC condition, after sign pre-handling and highlight extraction, disconnected prepared ML calculations are used to differentiate user's features. The result is then mapped to an apt robot hand. It can imitate the client's activities in a constant way.

The design of the IoT-empowered stroke restoration framework is demonstrated as follows:

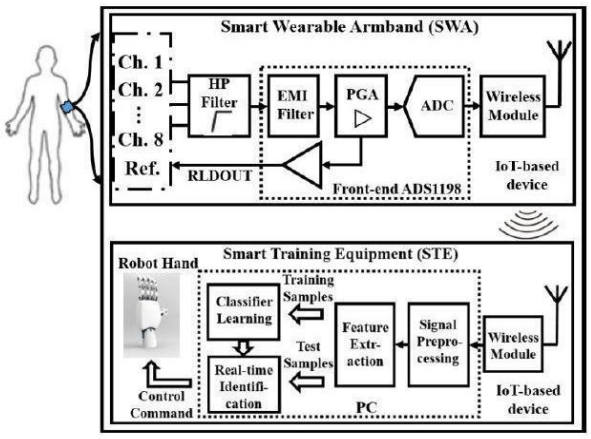

Fig 7

A fall detection database is presented in [6] to understand how detection algorithms perform. Here, the database initially collects sample data from 24 females and 26 males while they're performing 15 sorts of day by day exercises, for example, strolling, running, etc. A total examination of the databases that right now exist and of the proposed database is made. Four algorithms (k nearest neighbour, the artificial neural network, support vector machine, and kernel Fisher discriminant) are used to evaluate the databases' abilities and how we could rely on them. Assessment is made utilizing the conventions dependent on the fall discovery database, and the exhibition of the four calculations is given for the accompanying goals:

- essential evaluation of the database utilizing the fall recognition calculations;
- distinguishing the qualities and shortcomings of the normal calculations; and
- get the result of assessment for two and different classes dependent on the database.

The proposed device in [7] is a wearable smart glass which has an IR sensor module, a Bluetooth wireless communication module and a cloud system for data management. The glasses are based on desired conditions to detect drowsiness or fatigue.

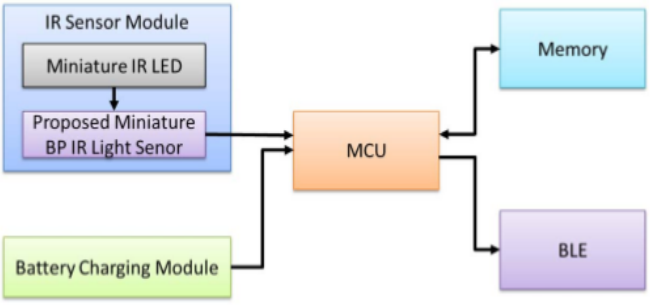

Fig 8

From the block diagram above which shows the proposed smart glass, we have the following:

- The eye base sleep detection theory which states "drowsiness can be detected when the eyes are closed for a very long time(1-2 seconds)" is used to detect drowsiness.
- A miniature bandpass IR photodetector is used to minimize ambient environmental light and enhance detection accuracy and helps in DFD recognition.
- DFD recognition is a program each driver's characteristics. The DFD mode sends an alert to the IVI in the vehicle via Bluetooth when an inclination toward drowsiness is detected.
- Drowsiness is detected from the reflection conditions of the pupil via the bandpass sensor.

The methodology used in [8] has an azobenzene compound and a curing agent was prepared, mixed and is coated on the glass optical fiber, a fiber strain probe is coated with a UV stretchable polymer at three different positions and thickness, an optical distributed strain sensor interrogator (ODiSI) with a sensor is used to continuously measure strain and temperature. The UV sensor probe the strain sensor interrogators measure the UV-induced strain of the azobenzene coated optical fibers. Azobenzene changes its phase when exposed to UV light. Three UV LEDs are installed at different positions to measure the strain induced. The LEDs are installed at different positions and are connected with the OdiSI system. The effect of UV exposure, the strain on the probe and changes due to UV light is measured by the UV sensing LEDs mounted at different positions. The strain on the probe increases as the intensity of the UV light increases. The schematic diagram of UV sensor probe is shown below:

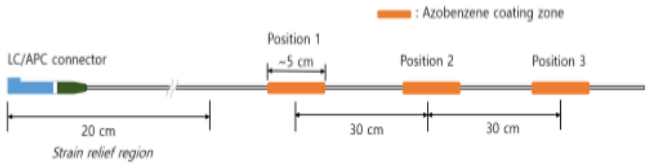

Fig 9

The temperature sensing structure in [9] is a cascade of two FPIs(Fabry-Perot interferences) and a Vernier effect mechanism. As temperature changes, a variety in the length of detecting FPI happens. In FPI based sensors, the optical path difference(OPD) changes as indicated by encompassing temperature. OPD is corresponding to the result of hole length and refractive list of the depression media. The temperature sensitivity variation is expressed as

$$S = \frac{\partial \lambda_m}{\partial T} = \lambda_m \left(\frac{1}{n} \cdot \frac{dn}{dT} + \frac{1}{L} \cdot \frac{dL}{dT} \right), m = 0, 1, 2...$$

The plausibility and execution of the proposed sensor is illustrated by placing the FPI on a thermo electric cooler. The temperature is fixed at 20 °C. As the temperature rises, a lower envelope spectra is acquired by bend fitting. An unmistakable range of Vernier impact, a progression of detecting FPIs and reference FPIs with various pit length are readied. The experimental setup is shown below:

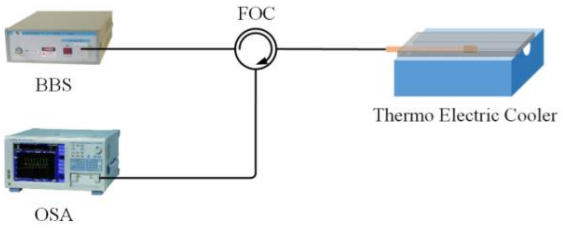

Fig 10

Feasibility and performance are demonstrated by placing the FPI on a thermo electric cooler. The temperature affectability of the single FPI is a negative an incentive because of the way that the cavity length diminishes as the temperature rises. Vernier effect improves the affectability and subsequently, the temperature affectability can be modified by changing the depression length distinction of the two pits. The device in [10] uses the technologies as shown in the below figure:

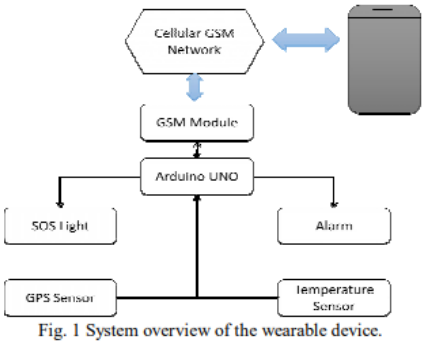

Fig. 1 System overview of the wearable device.

Fig 11

It includes GPS location sensor which determines the location of the child wearing the safety device in real time and sends this to the Arduino UNO. There is also a Temperature sensor that measures the temperature of the surroundings through the thermistor that is attached to it. SOS light which alerts the nearby people about the child in distress by flashing the universal light symbol on the device and the alarm helps the parents to locate the child or children when they get separated from their parents by sounding a loud alarm.

The system in [11] has a MEMS sensor that detects abnormal vibration and is controlled by NodeMCU. This refers to a firmware on IoT platform. The Global System for Mobile Communication is used to transmit voice and data services ,by operating at certain range of frequency bands. The GPS provides the location information which is updated to the server webpage and it is interfaced with the NodeMCU. The system used in [12] runs on a microcontroller platform and it forms the control unit of the device and consists of capacitors, reset circuitry, Pull up resistors and so on .The system consists of a Power Supply

section that is enabled with transformer to provide power to the other components of the device. The Temperature sensor senses the surrounding temperature and uses a thermistor to do this. This device also uses Liquid Crystal Display(LCD) to display the information regarding the current status of the system , an LED as an indicator lamp, an LDR that measures light intensity and a Buzzer section to alert the completion of a process, along with GPS and GSM modules for tracking location and communicating with the user device.

This system is shown in a block diagram below:

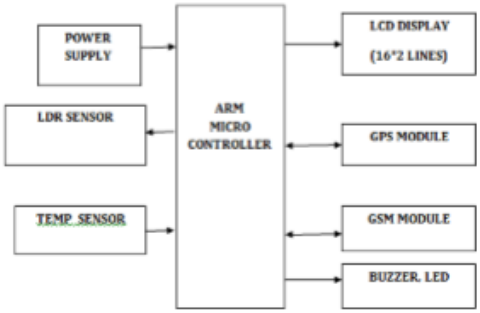

Fig 12

III. RESULT COMPARISON

[1] Demonstrates that a smart IoT device can be used to track and monitor the safety of a child. If any abnormal values are read by the sensor then an SMS is sent to the parents' mobile and an MMS indicating an image captured by the serial camera is also sent. [2] A child guard system for mobile devices helps parents and guardians monitor their children. The application is a low cost system that monitors real time location and the physical states of the child with ease. [3] Is a wrist worn device for complete and personalized environment parameter monitoring. The prototype uses a multi-layer, multi sensor approach where in different layers share the same buses which are inter-connected on the board to carry out a specific task. The device is capable of detecting hazardous gases and also monitors physical parameters. [4] The aftereffects of WE-Safe IoT venture shows that the framework can give solid and continuous information. The sensor node(WE-Safe), depends on an altered sensor hub which is low, self-fueled and steady of numerous ecological sensors. This wellbeing checking system works in a dependable way utilizing vitality gathering. The IoT stage displays new open doors for forestalling medical problems to those exposed to capricious conditions. [5] Displays a Savvy Wearable Armband for stroke survivors. It comprises of a brilliant wearable armband, and a 3D printed robot hand. The wearable armband is unpretentious, agreeable, and simple to-utilize which can be effectively applied on client's lower arm without the need of expert information or clinical help. It has been demonstrated that such robot-helped dynamic preparing is more viable than aloof techniques, and can upgrade remedial impacts. [6] This examination displayed a database that was made dependent on information gathered by three tri-hub sensors in a genuine situation. It depicts the current databases and the distinction between this examination and those of others. All in all, the primary attributes of the database have three angles: 1) enormous scope information made out of 9,379 examples from 50 subjects; 2) different of the exercises, including 11 sorts of ADL and 4 sorts of falls; and 3) the authenticity of the exercises recorded, itemized data, and an efficient structure. Along these lines, the database advances existing databases and gives an apparatus to improved examinations.

[7] A smart glass is proposed in this paper to increase road safety. An IR bandpass sensor is mounted on the device which increases detection efficiency and minimize ambient environment light. A DFD program reads the driver's characteristics and transmits an alert to the IVI of the vehicle which in-turn transmits a warning via the speakers to alert the driver. A diagnostic bridge is used to process the DFD warning pass alerts by flickering the tail lights or by playing sounds in the vehicle. A cloud based administration stage is utilized by organizations to follow the weariness status of their drivers. If drowsiness is detected, a series of reminders are sent via the IVI of the vehicle(through speakers) or flickering lights which alerts the driver/other vehicles. [8] A decentralized UV sensor which utilizes practical polymers and fiber based appropriated strain estimation techniques to distinguish changes because of UV light. A practical polymer azobenzene is utilized to insist changes started on account of UV light. An azobenzene containing polymer was made and a fiber secured with it for the spread strain estimation, to confirm that UV entrance. The reaction to change is recorded at interims of 1 second.

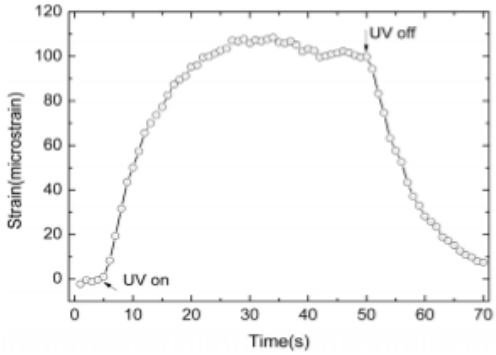

Fig 13

In [9] a conservative fiber temperature sensor made out of two fell FPIs with ultrahigh affectability is proposed and illustrated. A qualification in the length of the two FPIs adds to the age of Vernier impact, which improves acknowledgment affectability by one request for size. Three different sensitivities can be exhibited by falling the two FPIs and fitting the lower envelope of the reflection range. To fulfill various requests, the affectability amplification factor can be physically balanced by controlling the pit length distinction of these two FPIs.

[10] The technological components used in this device are subjected to various tests .When these components were tested, the GPS sensor resulted in responding back with exact coordinates of the device to the cellphone of the user. In a similar manner the temperature sensor resulted with a response time of under a minute when keyword "Temperature" was sent. The SOS light and the alarm would perform the appropriate function when an SMS was sent, rather than responding with any measurements to the sender.

[11] The device provides the parents with results in two ways, either an SMS or a graphical representation of the location that includes latitude, longitude, MEMS and vibration sensor measurements. A major drawback of this system is that it provides accurate results only with high internet connection. [10] ,this paper uses very less components and also provides the output or result in graphical form as well.

[12] Compared to the other two papers, i.e., [10][11] this paper specifies a device that uses a lot more components like LED and LDR and it has a buzzer similar to paper 10. This system provides results of the components to the parents which includes real time temperature, location, Ultrasonic radiation index, LED light and a distress buzzer of the child's surroundings. This provides parents with the ability to locate their child and to buzzer if the child is in distress which alerts the people nearby to provide comfort to the child in response.

IV. CONCLUSION

This paper surveys various papers related to an IOT based safety wearable device that helps the parents or guardians to monitor the safety of their ward or children. The main aim is to provide an effective and convenient solution to the parents or guardians to keep track of their child's safety and in turn to reduce the increased occurrence of crime against missing children.

The paper compares the methodologies and the results gained from all of these papers. The Safety wearable device consists of various IOT sensors that provide information about parameters like temperature, UV, location etc. and the values recorded by these sensors are stored on the cloud. In summary, the parents or guardians will be alerted if abnormal values are read by the sensor or if values on these sensors cross a given threshold value, alerting them that the child could be in danger. This helps the parents to locate and monitor their child's safety.

The future work would be to further develop and implement the safety wearable device so that it could be sown into a fabric(clothes) that could be worn, using synthetic fibres again for which we will refer the papers that were surveyed on this paper.

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