Design and Implementation of a Novel Sensor Network System for IoT- Connected Safety and Health Applications using Android Gateway

Manjushree C[1], Tushita R[2], Sahanashree[3], Meghana P[4], Jagadeesh B N[5]

[1]Student, Department of CSE, East West Institute of Technology, Bengaluru, Karnataka, India
[2]Student, Department of CSE, East West Institute of Technology, Bengaluru, Karnataka, India
[3]Student, Department of CSE, East West Institute of Technology, Bengaluru, Karnataka, India
[4]Student, Department of CSE, East West Institute of Technology, Bengaluru, Karnataka, India
[5]Assistant Professor, Department of CSE, East West Institute of Technology, Bengaluru, Karnataka, India

---***---

Abstract - *This paper presents a novel sensor network system for Internet of Things (IoT) connected safety and Health Applications. The projected network system incorporates multiple sensors to monitor environmental and physiological parameters. The sensors will communicate with each other and transmit the data to an android mobile via Bluetooth that forms heterogeneous IoT platform. The sensor node can offer a good notification and warning mechanism for the users once harmful environments are detected. A smart IoT gateway is enforced to provide data processing, local web server.*

Key Words: Novel sensors, Bluetooth, Connected Health, Safety, Smart IoT gateway.

1.INTRODUCTION

In recent years Internet of Things (IoT) has become a promising technological paradigm and attracted several analysis interests. It is expected that there will be twenty six to fifty billion internet connected devices by 2020 and hundred billion by 2030. The IoT is enabled by the most recent developments in RFID, smart sensors, communication technologies and Internet protocols. The essential premise is to possess smart sensors is to collaborate directly without human involvement to deliver new category of applications. The present revolution in Internet, mobile and machine-to- machine (M2M) technologies are often seen as the initial phase of the IoT. Within the returning years, the IoT is anticipated to bridge various technologies to change new applications by connecting physical objects along with the support of intelligent decision making.

The Internet of Things could be a paradigm where everyday objects can be often equipped with characteristic, sensing networking and processing capabilities that may enable them to communicate with one another and with other devices and services over the web to accomplish some objective. Internet, the networks of networks avails us the planet at one click. This paper is a survey on Internet of Things that is believed to be succeeding evolution of Internet. The Internet of Things could be a

paradigm where everyday objects can be often equipped with characteristic, sensing evolution of Internet. The Internet of Things (IoT) bridges the cyber and therefore the physical worlds. Ultimately, IoT devices are context-aware and change close intelligence.

A novel sensor network system is employed for environmental and physiological monitoring. For industrial workplace, safety is particularly important especially for employees ceaselessly ever-changing their working environments between between indoor and outdoor. UV, Ozone, Carbon monoxide (CO) and particular matter (PM) are harmful to human health in outdoor environments.

Each person is equipped with 2 nodes of 4 sensors i.e for environment monitoring gas sensor and temperature sensor are utilized and for physiological monitoring heart beat sensor and human body temperature sensor are utilized. A smartphone-based IoT gateway is developed to scale back the dependency of the fixed gateway location.
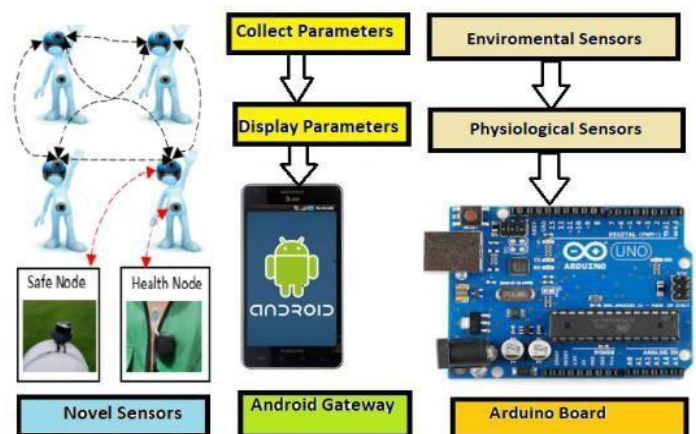

Fig -1: A Novel Sensor Network System Architecture

The above figure represents a novel sensor network system with the Arduino board having the Android Application as the fixed gateway location. Must not be used. Other font types may be used if needed for special purposes.

---

2. SYSTEM ARCHITECTURE AND DESIGN

System Architecture and design - identifies the general hyper media structure for the WebApp. Architecture design is tied to the goals to be established for a WebApp, the content to be conferred, the users who will visit, and therefore the navigation philosophy has been established. Content architecture, focuses on the style within which content objects and structured for presentation a navigation. WebApp architecture, addresses the style within which the application is structured to manage user interaction, handle internal processing tasks, impact navigation and gift content.

2.1 Sequence Diagram

A sequence diagram merely depicts interaction between objects in a very consecutive order i.e. the order within which the interactions take place. We can conjointly use the terms event diagram or event eventualities to refer a sequence diagram. Sequence diagram describes how and in what order the objects in a system operate.
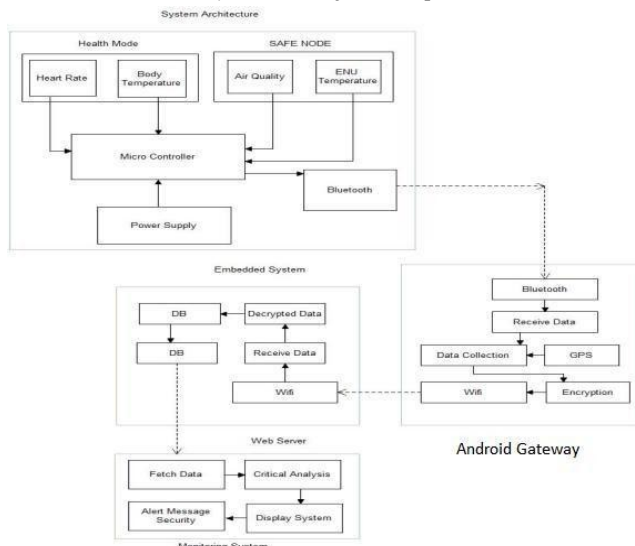

Fig -2: System Architecture

2.2 Data Flow Diagram

A data flow diagram (DFD) is a graphical illustration of the "flow" of data through an information system. A data flow diagram can also be used for the visualization of data processing (Structure Design). It is common practise for a designer to draw a context level (DFD) first which shows the interaction between the system and outside entities. DFDs show the flow of data from external entities into the system, how the data moves from one processor to another, in addition to its logical storage. There are only four symbols: squares representing external entities, which are sources and destinations of information getting

into and going away from the system. Rounded rectangles representing process, in alternative methodologies, may be called 'Activities', 'Actions', 'Procedures', 'Subsystems' etc. which take data as input, do processing thereto, and output it.

Arrows representing the data flows, house which may either be electronic knowledge or physical things. It is not possible for data to flow from data store to data store expect via a process and external entities or not allowed to access data stores directly. The flat 3-sided rectangle is representing data stores ought to each receive information storing and provide it for more processing.
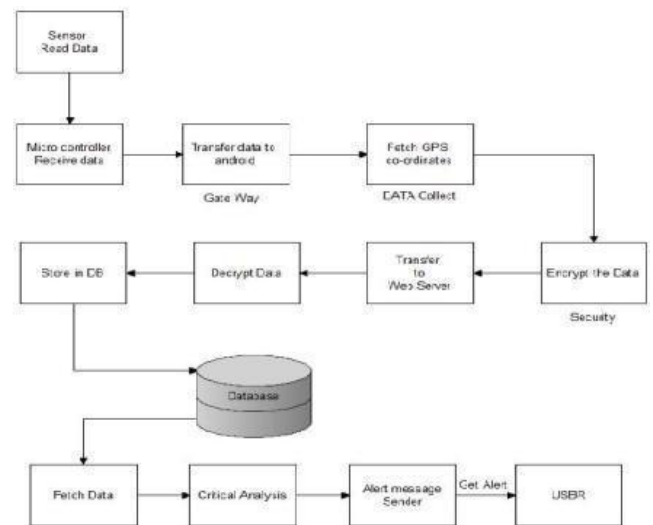

Fig -3: Data Flow Diagram

The above figure illustrates the flow of data from the sensors to the database for encryption and decryption of data and for causation of alert messages to the user.

3. REVIEW OF SENSORS AND SMART OBJECTS

Presently we have a tendency to a complete wireless sensor network that's supported totally on different frequencies to get rid of interference problems as well as to apply to different environments. We use gas sensor, heart rate sensor, environmental and body temperature sensor to monitor the environmental and physiological parameters.

3.1 Heart Rate Sensor

A person's heartbeat is that the sound of the valves in his/her's heart catching or increasing as they force blood from one region to a different. the number of times the center beats per minute (BPM), is that the center beat rate and beat of the center which will be felt in any artery that lies in getting ready to the skin is that the pulse. The fundamental heart beat device consists of light emitting diode and a detector form of a light police work

resistance or a photodiode. The center beat pulse causes a variation among the flow of blood to completely different regions of the body. Once a tissue is well-lighted with the sunshine supply, i.e. light emitted by the crystal rectifier, it either reflects (finger tissue) or transmits the light(earlobe).Some of the light absorbed by the blood or transmitted or the mirrored light is received by the sunshine detector.

The amount of sunshine absorbed depends on the blood volume there in this tissue. The detector output is among the sort of electrical signal and is proportional to the heart beat rate.
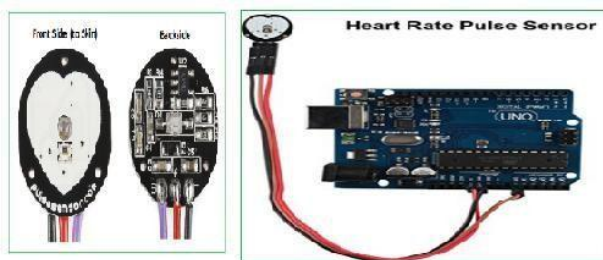

Fig -4: Heart Rate Sensor

To realize the task of obtaining the AC signal. The output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or simple using ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate, given by the formula - BPM (Beats Per Minute) = 60*f where f is pulse frequency.

3.2 Temperature Sensor

Temperature sensor could be a device that's supposed specifically to live the hotness or coldness of academic degree object. DS18B20 could be a precisioness IC Temperature device with its output proportional to the temperature (in zero C). With DS18B20 the temperature are measured loads additional accurately than with a thermostat. It in addition possesses low-self heating and does not cause quite 0.10C temperature rise in still air.
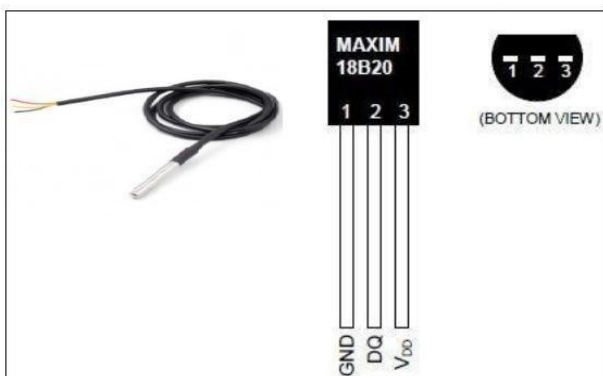

Fig -5: Temperature Sensor

The in operation temperature varies from -55°C to 150°C. The DS18B20's low output resistance linear output, and precise inherent activity build interfacing to readout or manage equipment notably simple. It's found its applications on power provides, battery management, appliances, etc.

3.3 Bluetooth Sensor

Bluetooth could be a wireless technology commonplace for exchanging information over short distances exploitation short wavelength ultrahigh frequency radio waves 2.4 to 2.485 rate from mobile device and building personal space networks.
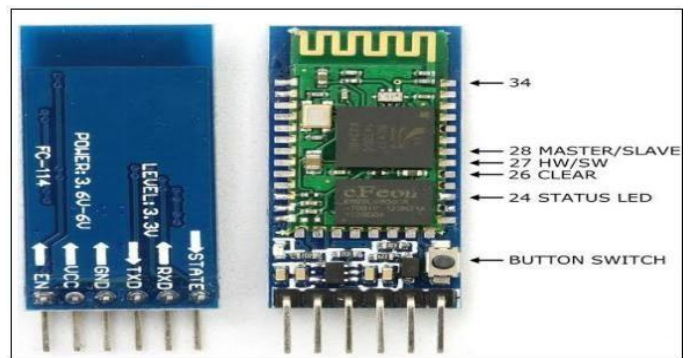

Fig -6: Bluetooth Sensor

Initial of all, connect the Arduino Uno to the laptop or microcomputer with the help of Usb cable. Afterwards set the com port in your laptop for Arduino Uno and transfer the sketch or program code. Once uploading the program to the Arduino Uno. The longer term job is connecting the Bluetooth module HC-05 to the Arduino Uno.

3.4 Gas Sensor

It's a dangerous gas detection instrumentation for the family, the atmosphere applicable for ammonia, aromatic compounds, sulphur, benzene vapour, smoke & various harmful gas detection, gas-sensitive part check.

Fig -7: Gas Sensor

Air quality device is for detection a decent vary of gases, as well as NH3, NOx, alcohol, benzene, smoke and gas. Ideal to be used in geographic point or factory with simple drive and observation circuit.

4. REVIEW OF ANDROID GATEWAY

Android could be a complete set of software package for mobile devices like portable computers, notebooks, smartphones, electronic book readers, set-top boxes etc. It contains a linux-based OS, middleware and key mobile applications. It may be thought of as a mobile OS. However it's not restricted to mobile solely. It's presently utilized in numerous devices like mobiles, tablets, televisions etc.

Fig -8: Android

Before learning all topics of android, it's needed to understand what's android. Android could be a software package and UNIX operating system mostly for mobile devices like tablet computers and smartphones. It's developed by Google and later the OHA (Open telephone set Alliance). Java language is principally used to write the android code even if different languages could be used.

The goal of android project is to create a successful real-world product that improves the mobile experience for end users. There are many code names of android such as Lollipop, Kitkat, Jelly Bean, Ice cream Sandwich, Froyo, Ecliar, Donut etc.

4.1 Android Emulator

The Android Emulator is an Android Virtual Device (AVD), that represents a selected mechanical man device. We will use the Android emulator as a target device to execute and check our mechanical man application on our laptop. The Android Emulator provides the majority the practicality of a true device. We will get the incoming phone calls and text messages. It additionally offers the situation of the device and simulates completely different network speeds. mechanical man copycat simulates rotation and different hardware sensors. It accesses the Google Play store, and far additional.

Testing Android Emulator applications are typically quicker and easier than doing on a true device. for instance, we will transfer information quicker to the copycat than to a true device connected through USB.

Fig -9: Android Emulator

The Android emulator comes with predefined configurations for several Android phones, Wear OS, tablet, Android TV devices.

4.2 Android Architecture

Android architecture is classified into 5 parts: Linux kernel, native libraries (middleware), Android Runtime, Application Framework, Applications.
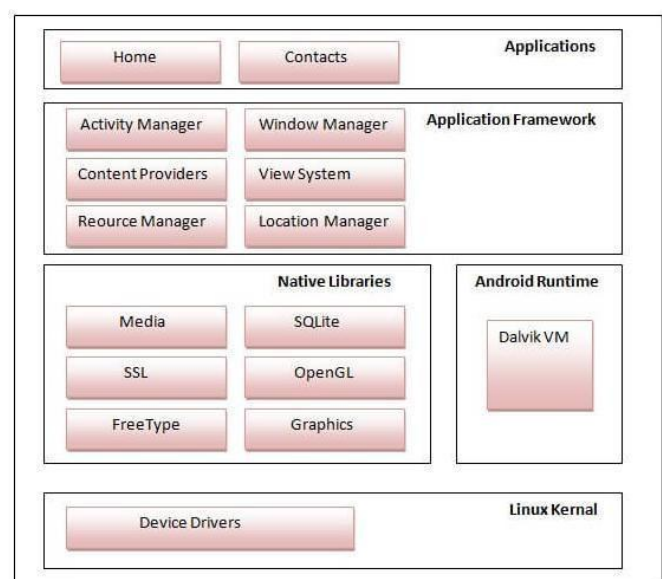

Fig -9: Android Architecture

● **Linux Kernel:**
It is the center of Android Architecture that exists at the On the top of Linux kernel, Linux Kernel is to blame for device drivers, power management, memory management device management and resource access.

● **Native Libraries:**

On the top of Linux kernel, the Native Libraries like Webkit, OpenGL, FreeType, SQLite, Media, C runtime library (libc) etc. The WebKit library is chargeable for browser support, SQLite is for info, FreeType for font support, Media for taking part in and recording audio and video formats.

● **Android Runtime:**

In Android runtime, there are unit core libraries and DVM (Dalvik Virtual Machine) that is accountable to run mechanical man application. DVM is like JVM however it's optimized for mobile devices. It consumes less memory and provides quick performance.

● **Android Framework:**

On the top of Native libraries and Android runtime, there's Android framework. Android framework includes Android API's like UI (User Interface), telephony, resources, locations, Content suppliers (data) and package managers. It provides tons of categories and interfaces for Android application development.

● **Android Framework:**

On the top of Android framework, there are applications. All applications like home, contact, settings, games, browsers are using Android framework that uses Android runtime and libraries. Android runtime and native libraries are using Linux kernel.

5. RESULT ANALYSIS

A result's the ultimate consequence of actions or events expressed qualitatively or quantitatively. Performance associate analysis is an operational analysis, may be a set of basic quantitative relationship between the performance quantities.

The ultimate result displays the Sensors, Arduino board and the Android gateway used to monitor the harmful environmental and physiological conditions, the various parameters will be collected. The collected information will be encrypted and decrypted within the Android application and it'll show the resultant information from the senors. The collected information is stored in the database.
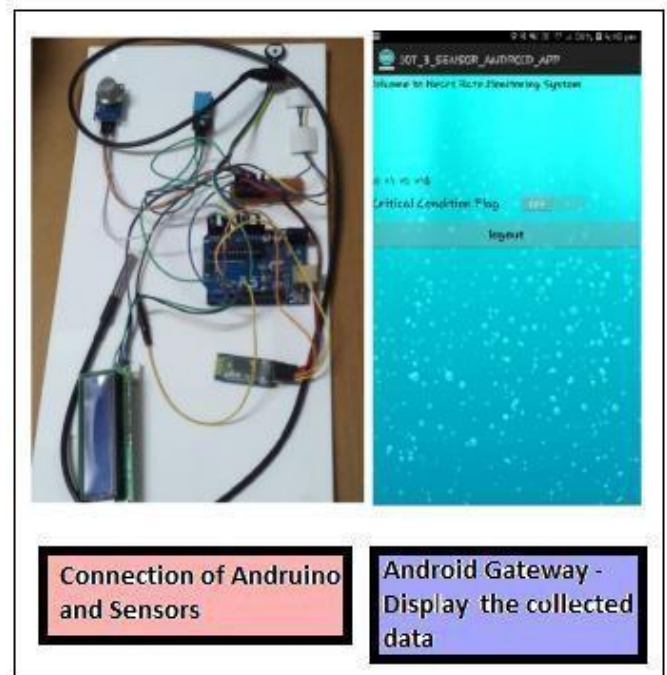

Fig -10: Final Result

The above figure shows various sensors connected to the Arduino board and then to the Android gateway.

CONCLUSION

In this paper, we are presenting a novel sensor network system for connected health and safety applications for industrial workplaces. The arrangement is in a position to observe each physiological and environmental information forming a network from wearable sensors connected to employees' body and supply invaluable data through the bluetooth to the system operator and workers for safety and health observation.

REFERENCES

[1] D. Antol´ın, N. Medrano, B. Calvo, and F. P´erez, "A wearable wireless sensor network for indoor smart environment monitoring in safety applications," Sensors, vol. 17, no. 2, p. 365, 2017.

[2] J. Dieffenderfer, H. Goodell, S. Mills, M. McKnight, S.Yao, F. Lin, E. Beppler, B. Bent, B. Lee, V. Misra et al., "Low-power wearable systems for continuous monitoring of environment and health for chronic respiratory disease," IEEE journal of biomedical and health informatics, vol. 20, no. 5, pp. 1251 1264, 2016.

[3] Australian Safety and Consultation Council (ASCC), "Guidance note for the protection of workers from the ultraviolet radiation in sunlight", Canberra: Commonwealth of Australia, 2008.

[4] M.Blumthaler,"Uv monitoring for public health", International journal for environmental research and public health, vol. 15, no. 8, p. 1723, 2018.

[5] J. A. Bernstein, N. Alexis, C. Barnes, I. L. Bernstein,A. Nel, D. Peden, D. Diaz-Sanchez, S. M. Tarlo, and P.B. Williams, "Health effects of air pollution," Journal of allergy and clinical immunology, vol. 114, no. 5, pp. 1116-1123, 2004.

[6] E. Jovanov, A. Milenkovic, C. Otto, and P.C.De Groen, "A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation," Journal of Neuro Engineering and rehabilitation, vol. 2, no. 1, p. 6, 2005.

[7] P. Pace, G. Aloi, R. Gravina, G. Caliciuri, G. Fortino, and A. Liotta, "An edge-based architecture to support efficient applications for healthcare industry 4.0,"IEEE Transactions on Industrial Informatics, vol. 15, no. 1, pp. 481-489, 2019.

[8] F. Wu, J. Redout, and M. R. Yuce, "We-safe: A self-powered wearable iot sensor network for safety applications based on lora," IEEE Access, vol. 6, pp. 40, 846–40 853, 2018.

[9] D. Robertson, "Health effects of increase in the concentration of carbon dioxide in the atmosphere," current science, pp. 1607–1609, 2006.

[10] F. Wu, T. Wu, and M. R Yuce, "An internet-of-things (iot) network system for connected safety and health monitoring applications," Sensors, vol. 19, no. 1, p. 21, 2019.

BIOGRAPHIES

Manjushree. C is a final year student of Department of Computer Science and Engineering. East West Institute of Technology, Bengaluru

Tushita. R is a final year student of Department of Computer Science and Engineering, East West Institute of Technology, Bengaluru

Sahanashree. S is a final year student of Department of Computer Science and Engineering, East West Institute of Technology, Bengaluru.

Meghana. P is a final year student of Department of Computer Science and Engineering, East West Institute of Technology, Bengaluru.