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Smart Defence Head-Gear

Siddhant Chandra[1], Parmanand Chaurasiya[1], Rajesh Gupta[2], Sunny Patwa[4]

[1]ECE Department, IMS Engineering College, AKTU,

NH-24, Adhyatmik Nagar, Ghaziabad, INDIA

[2,3,4]ECE Department, IMS Engineering College, AKTU,

NH-24, Adhyatmik Nagar, Ghaziabad, INDIA

ABSTRACT

Recent decades of technological advancements have seen a sharp surge in the penetration of technology and its applications in the defence sector. Newer devices with technological support systems and ease of accessibility are emerging rapidly. Conventionally, a soldier's helmet is some shielding structure that protects him/her from injuries that may happen due to an attack or collision with some hard surface. It rendered the manufacturers to be precisely oriented towards the elemental structure of the soldier's helmet making it much more robust, rugged, tough, highly comfortable & light weight. This paper introduces a Smart Helmet that has some cutting edge communication & sensory technologies embedded right into it. With the evolution of Internet of Things it becomes almost inevitable to keep communication devices untouched of it and this Helmet makes the most out of it. The paper contains the idea of building a Smart Helmet for the Soldiers that caters for biological and physical monitoring and defence assistance. The problem in which a soldier's primary communication (radio) systems fail to work is resolved with this device as it forms a secondary communication link between the soldier and the locally established central server. A set of sensors pave the way for collecting various data in the soldier's sphere of action and are connected together through an AtMega-2560 (Arduino Mega Board). The advantage that this system possesses over the other pre-existing similar systems is that it employs the Wi-Fi communication platform using the ESP 8266 Wi-Fi module making it fast and allows for real time monitoring and manipulation. Moreover the USP of the Device is its capability to warn the soldier against any chemical attack based threats as an Air Quality Sensor MQ-135 is incorporated into it. The soldier's health and the battlefield's environmental stats can be monitored essential for assisting him/her in the warfare. The device holds the potential to replace the existing radio communication technology and boasts of having several advantages over the preexisting systems.

1. INTRODUCTION

Smart Defence Head-Gear serves for two different types of problems at the warfare. The primary objective that it fulfills is that it helps in monitoring of the health status of the soldier and the environmental conditions at the warfare. A pulse sensor also known as Heart Sensor keeps a track of the pulse rate of the soldier and if the soldier gets injured resulting into bleeding, a lower heart rate hence will alert the central control about the same so that necessary medical assistance can be sent to the soldier at his tracked location using the embedded GPS sensor. An atmospheric temperature and humidity sensor DHT-11 senses the temperature variations around the soldier and alerts the central control in case of abrupt rise in atmospheric temperature indicating an explosion near the respective soldier and rendering the central control to send extra troops and medical assistance to that specific location.

The second purpose that the device solves is of alerting the soldier against possible chemical attacks that may occur at the battlefield through the means of the Air Quality Sensor. The sensor takes a record of the air quality and detects poisonous gases on the grounds of conductivity. More the impurity in air, greater is the conductivity. In case there is a chemical attack, the conductivity of the air rises, which is recorded by the MQ-135 and once its set threshold is crossed, a buzzer mounted in the device alerts the soldier and he/she can put upon his her special mask that cancels the effect of the harmful gas or he/she may escape the area immediately guided by the decreasing buzzer intensity depicting decreasing impact of poisonous air.

The proposed device has an edge over existing similar devices as it works on IOT platform that is all the communication happens over the internet which makes the entire exchange of data possible in real-time. It is fast and highly reliable as there is no chance of delay provided proper connection is established unlike the GSM based systems in which data was either delayed or lost at times. Also, the data in GSM based system cannot be encrypted and hence is prone to hackers who might steal or manipulate it. Whereas the data in an IOT system can be encrypted at various different levels making it highly secure and reliable. Moreover, the device is extremely light weight as compared to the existing heavy radio communication systems. It paves the way for much more comfort for the soldier using the device. The central control where the entire monitoring is done can perform various actions using the collected data by proper analysis of data trends and patterns. In fact, a complete track-sheet involving the action patterns of the enemies and the significant locations can be created.

Although the applications of the device are largely intended for the soldiers, however, it can come to usage at industries as well. The industries wherein the workers are exposed to high temperatures like thermal & nuclear power plants, mines etc. are more or less places where the device can be highly useful to monitor the health of worker and of course the physical conditions existing at the workplace.

2. SMART DEFENCE HEAD-GEAR

2.1 Working

The heart of the system is the Arduino AtMega 2560 microcontroller that binds all the sensors together. It is programmable and can be programmed as per the need using the Arduino Integrated Development Environment (Arduino IDE) in embedded C. The sensors collect the data and transfer it to the Arduino for processing and calculations. The Arduino works on the data on the basis of the instructions given in the code. The Arduino is interfaced with the ESP-8266 Wi-Fi module. The Wi-Fi module allows for the linking up of the device with the central server. All the data that is collected and processed is communicated to the central server. The various actions can be performed using the output pins of the Arduino based on the thresholds set in the code.

2.2 Block diagram

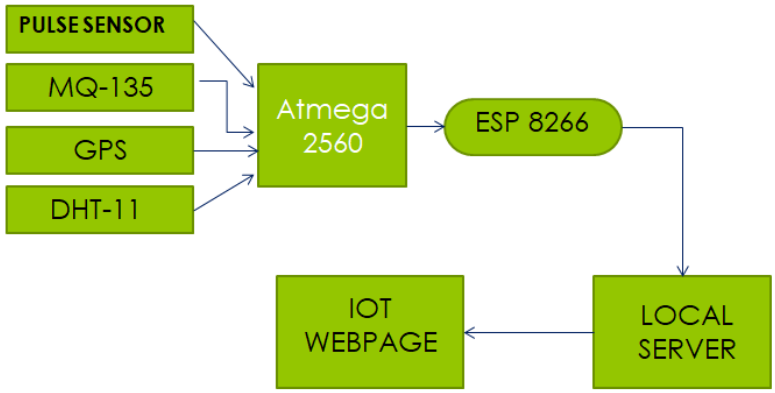

Figure 1: *System Level Block Diagram*

The block diagram of the proposed system is shown in figure 1. The heart of the system is the main block that has the Arduino Microcontroller that manages the entire flow of control. All the sensors are connected to the Arduino and the Arduino receives and performs analysis and calculations on the collected data based on the coding done in Arduino IDE. Through the Arduino the data is processed and communicated to the central server and back using the ESP 8266 Wi-Fi Module. The monitoring of data is done on the IOT webpage at the central control wherein the different visualizations are displayed as different fields. For the prototype we have used the third party Thing Speak IOT platform, but at the Military Base, since the defence forces are allotted a special set of frequencies restricted to the defence purposes only, the local server may use it for advanced security and isolation.

2.3 Operational flowchart

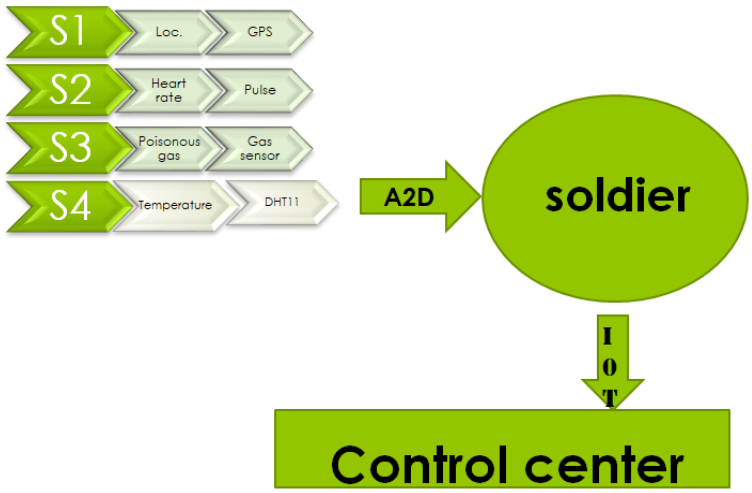

Figure 2: *Operational Flowchart*

2.4 The DHT-11 temperature and humidity sensor

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

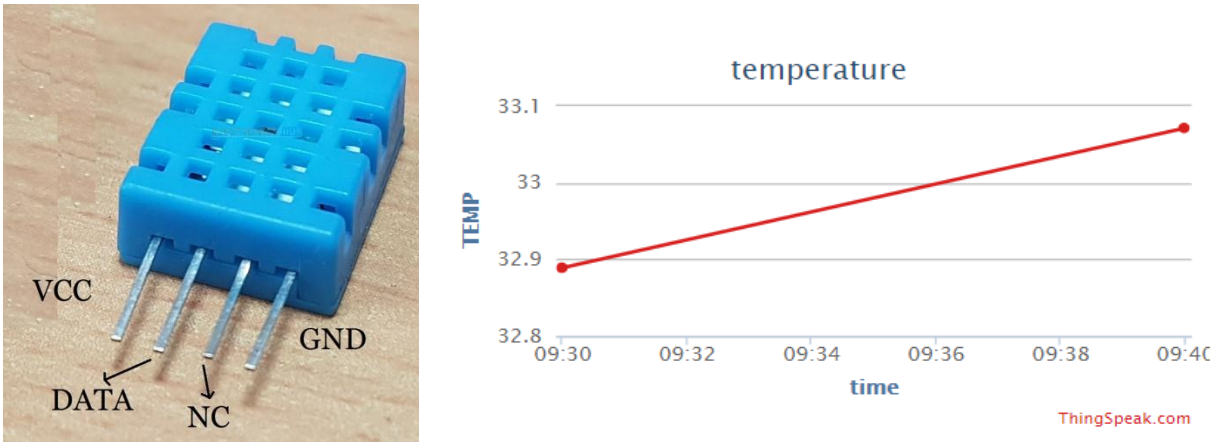

Figure: 3 *Temperature & Humidity Sensor*

2.5 The pulse sensor

Pulse Sensor is a low cost, very small size a plug-and-play heart rate sensor for Arduino and Arduino compatible boards. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects.

Pulse Sensor Amped adds amplification and noise cancellation circuitry to the hardware. It's noticeably faster and easier to get reliable pulse readings. Pulse Sensor works with either a 3V or 5V Arduino.

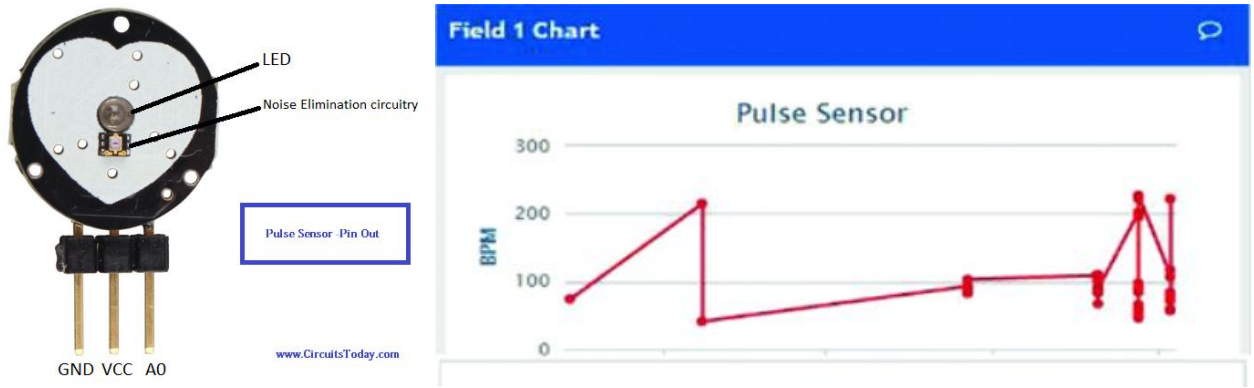

Figure: 4 *Pulse Sensor*

2.6 MQ-135 Gas Sensor

The MQ-135 gas sensor has a lower conductivity to clean the air as a gas sensing material. In the atmosphere we can find polluting gases, but the conductivity of gas sensor increases as the concentration of polluting gas increases.

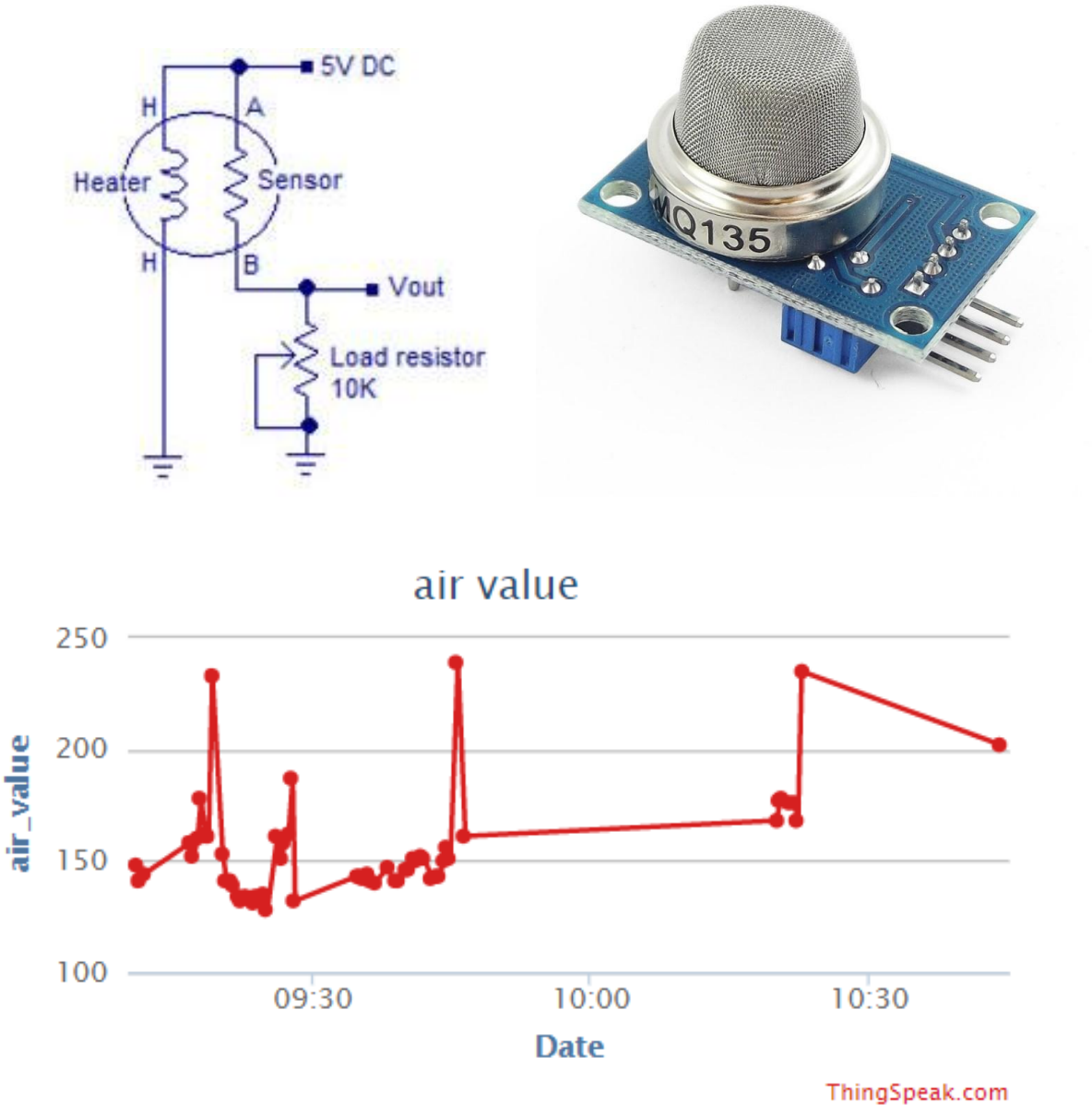

Figure: 5 *Air Quality Sensor*

3. CONCLUSION

The nations of the world are working extensively on defence sector and are making huge investments into it. This is because a strong defence system depicts greater power and dominance. Technology has undoubtedly been the backbone for almost all the path-breaking developments happening in the field and the proposed device will add another milestone to the fleet. The IOT communication system will pave the way for real time decision-making and quick assistance in times of need. A soldier is the priceless asset for any Nation and his life can be rescued in cases of nominal injuries by providing immediate medical treatment.

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Niket Patii, Brijesh Iyer; Department of E & TC Engineering, Dr. Babasaheb Ambedkar Technological University, Maharashtra

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