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Smart Clothes for Security Personnel

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Abstract: ***In national security, details matter butwaiting to get them right would lead to failure. Developing a centralised system to monitor the groups of security personnel would help in making vital decisions on time. Hence using IOT technology, we create a smart cloth which transmits live location and psycho-physiological data of security forces to a permissioned database where the data is analysed to understand the state of troops. These sensitive data are protected from tampering usingblockchain.***

Keywords: Centralised , IOT , Psycho-physiological data , Tamper , Blockchain

I. INTRODUCTION

The role of military and security forces has been sworn to protect the nation. They require a central organization to monitor those security forces .It is essential to ensure hierarchical commucation. In past decades , lack of communication has jeopardized the war .Security breach and tampering have became unacceptable starting from famous enigma attack. This created a need for developing a centralized system that allows monitoring the location and transmits psycho-physiological data of securityforces.

II. LITERATURESURVEY

Smart Fabrics is an integration of technology in clothing. Smart Clothing has proved to be helpful in various sectors like Healthcare, Sports, Fashion and Entertainment and so on. Smart Protective clothing can help security forces by reducing casualities at the time of operations.Luis M. Borges et al developed a smart cloth that integrates the clothes with the wired sensors dedicated exclusively to monitor the last 4 weeks of pregnancy.Developed smart clothes provide a hierarchical communication from garments to doctors . These sensors have been integrated in form of belt. In sensing task , electrodes for electrocardiogram (ECG) have been made ready.

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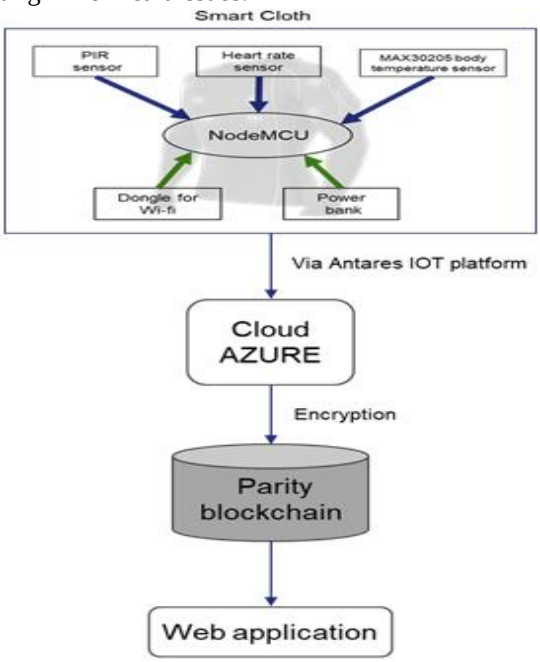
These smart clothes allow monitoring pregnant women either from home or hospital. MeikeReiffenranth et al research on smart protective clothing for law enforcement personnel developed by European research project Smartpro integrated the textile products with smart functionalities.Smart functionalities include heart rate sensors, geolocation module and wireless data transfer through textile antennas. The ultimate aim of the research is to provide solution for diverse applications including healthcare, sports and automotive industry to reduce causalities.Sofia scatagliniet al have published a research paper on actual wearable technologies prevailing in many applications. The paper is dedicated on collecting and summarizing the actual smart clothing in military field where health and safety plays a key role. It also encompasses innovation trend for innovative services .
DynaFeed has designed an innovative smart garment especially for athletes. It measures the voltage potential of wearer's heart by employing biosensor technology and polymer coating, accurately even when the person is in motion. The readings are accurate to 99.7% through the implementation of ECG method. In Sports field, smart clothes enhance the efficiency of workout, alerts about over-pressure/stress to a particular portion in the body, tracks the progress of fat burn, training intensity etc.,

III. BLOCKDIAGRAM

In the field of healthcare, Smart clothes that exist today can detect changes in heart rate and some are also capable of detecting minor heart issues.



A smart cloth has also been designed to diagnose the variations that arise in the ventricles of the heart.Despite all this great discovery and invention, there is still a need for the development of cardiac monitoring facilities that can precisely identify what is happening in our heart from the symptoms. Also there is a desparate need for a technology that can diagnose chronic illness. Akhil Nair et al has implemented gesture recognition in smart clothes using a hall effect sensor. The smart cloth consists of an array of sensors which work in coordination to recognize a gesture. The output is then sent to other electronic devices via Bluetooth. Myontec is a company that manufactures smart clothes (trousers, shirts) for monitoring muscle capacity and performance. It also employs technology for handling the measured data.

IV. PROPOSEDMETHODOLOGY

By employing highly efficient sensors in flexible and comfortable clothing, we can track the location and the vitals of security personnel. These details are then securely transferred to centralized applications using encryption and cloud technology, where they can be monitored constantly.

V. COMPONENTSREQUIRED:

A. HEART RATESENSOR:

The optical heart rate sensor is a sensor developed based onPPG (photoplethysmography) technology. PPG sensors employ a light-based technology to sense the blood flow rate as influenced by the heart's pumping action. The sensor gives a digital output in BPM. The average heart rate is 78 BPM. Voltage input to the sensoris3.3-6V.

Fig: Optical heart rate sensor.

PPG technology employed in this sensor is a relatively easy, simple and a cost efficient technique that detects heart beat rate from the changing blood volume in the microvascularbeds. Blood absorbs green light.Each timeout heart beats, it pumps blood into the vessels as a result of which more green light is absorbed. The intensity of reflected light captured by the sensor gives the density of blood pulse.

B. TEMPERATURESENSOR:

Maxim Integrated MAX30205 measures the human body temperature accurate to 0.1 degree Celsius, thereby meeting thermometer specification. It requires a low supply voltage ranging between 2.7-3.3V. Using a high resolution sigma-delta ADC, it provides a digital temperature output. It has an I2C compatible serial interface through which it can communicate with a host microcontroller. The sensor also has one-shot and shutdown modes to minimize power utilization. Indicates Overtemperaturethrough alarm orinterrupt.

Fig: MAX30205 human body temperature sensor

C. PIRSENSOR:

The Passive Infrared (PIR) sensor is used to detect the motion of a human body. PIR sensor consists of an on-board pyroelectric sensor for detecting the variation in IR levels emitted and it is enclosed within a dome-shaped Fresnel lens.The range of detection is 5m – 12m. It can be powered upto 5V and provides Standard TTL output. It has low noise and high sensitivity.

Fig: PIR sensor

D. NODEMCU

Development boards like Arduino and Raspberrypi are essentially mini-computers that can control sensors and connect to PC. To build an IOT system, these boardsmake use of an external Wi-fimodule as these boards do not have one in-built in them. NodeMCU is an open source firmware and development board which runs on the System on chip (SOC) called ESP8266. The inbuilt Wi-fienabled ESP8266 SOC is what contributes to the uniqueness of NodeMCU. NodeMCUcan be programmed using either the ArduinoIDE or the simple and fast Luaprogramminglanguage. Besides having a programmable Wi-Fi module, NodeMCU has 17 GPIO pins, anAnalog pin A0, a functional PWM, an in-built voltage regulator AMS 1117. It supports UART, I2C and SPI communication. It has a single chip USB to UART interface bridge (CP2102) with a communication speed of 4.5 Mbps. Also, it comprises of 128kb Static RAM memory and an external Flash.

Fig: NodeMCU version 1.0

ESP8266 module in NodeMCUoperating at a frequency of 2.4GHz can function as an access point ,Wi-ficlient or both. When the router acts as an access point and ESP8266 acts as a Wi-ficlient, the device is said to be operating in station mode. When the device acts as an access point, it allows nearby devices to connect to it.Features like low power requirement, integrated Wi-fi, smaller board size, cost efficiency and all the above mentioned properties makes NodeMCU more preferable for IOT applications.

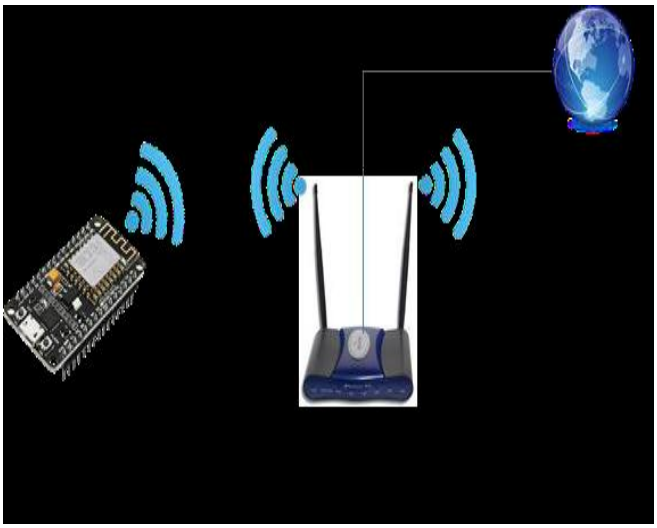


Fig: NodeMCU station mode – Overview

VI. GOOGLEGEOLOCATION:

Location of security personnel is found using Geolocation API which returns a location (latitude & longitude) and accuracy radius depending on information about cell towers and WiFinodes that the mobile client candetect.

VII. FLOCKING:

Flocking is a printing process in which short fibres are applied to an adhesive-coated surface. Here, the suggested adhesive is phenolic resin and methanol (0.6-0.8%). Flock fibre used is Nylon 66 and polyester due to their high electrostatic property. When these fibres with adhesive is made electric , the unlike charges attract and forms a bind. This flock printing was already used in china around 1000 BC. Later, in Europe it gained its popularity in the middle ages.

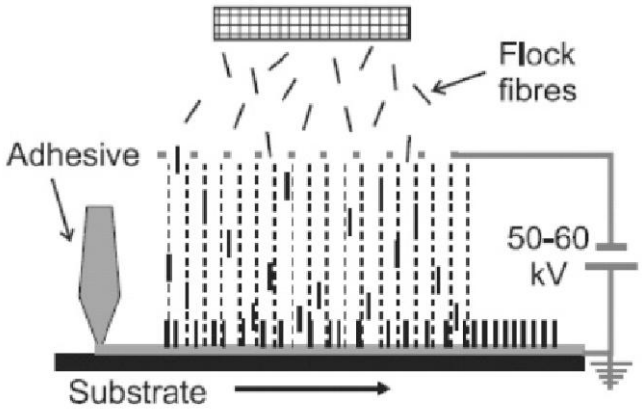


Fig: Diagrammatical representation of flocking process

VIII. INTERNET OFTHINGS:

The Internet of Things is changing much about the world we live in from the way we drive to how we get energy for our homes and many more. IOT is a connected environment which links a device to the Internet and to other connected devices. IOT is a huge network which connects things and people. Subtle sensors and chips are embedded within the physical things around us each transmitting invaluable data. These data are collected, managed and analysed on the IOT platform which are then stocked on the cloud, a virtual storage.

IX. ANTARES IOTPLATFORM:

Antares is an IOT platform which assists the conflation of data from sensors and actuators and perform data analytics on the collected data. The data gathered is pooled in the AZURE cloud. Antares ESP8266 library simplifies the fetching and employing of data to Antares IOT platform.

X. PARITYBLOCKCHAIN:

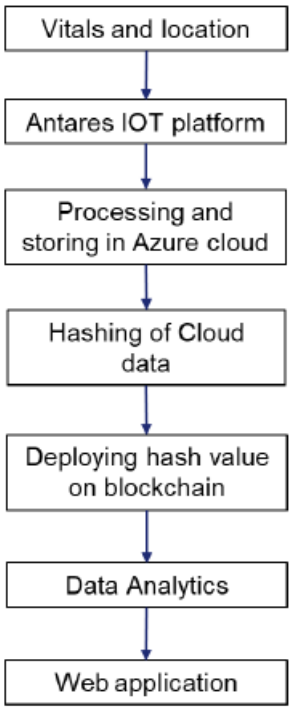
Blockchain is a linked-list of blocks which holds records/data. Any record on blockchainis secure and immutable. Here, we make use of Parity Blockchainwhich is an Ethereum based blockchain. Using Parity substrate, a blockchaindevelopment framework, we customize the blockchainaccording to our application. The data to be deployed on the blockchainis first hashed and the generated hash value is entered in the block, which makes tampering with data highlydifficult.

XI. WORKING:

Vitals such as heart rate in Beats Per Minute and Body temperature are sensed using the Optical heart rate sensor and MAX30205 sensor respectively. As an added functionality, PIR sensor is used to detect human motion around the person wearing smartcloth.Location of security personnel which is tracked using NodeMCU and Google Geolocation and the information obtained from the above mentioned sensors, embedded in clothes is then sent to AZURE cloud.

The Antares IOT platform integrates the location coordinates, heart rate BPM and Body temperature readings (in Fahrenheit) on the AZURE cloud. The data from cloud is then encrypted using hashing and deployed on the Parity blockchain, which acts as the database. All the location and vitals of security personnel are stored in Parity and analysedto find the condition of each individual securityperson. These details are displayed to monitoring centresvia a centralisedweb application which is linked with the database. The web app enables the authorities to monitor the data with ease. Time to time updated data is screened on the web app. It also helps them to attend to casualties on time.

XII. FLOWCHART:



XIII. FUTUREDEVELOPMENTS:

A. To enable transmission of vitals and location to monitoring centres in the absence of internet using GPS module, GSM module and a patch antenna.

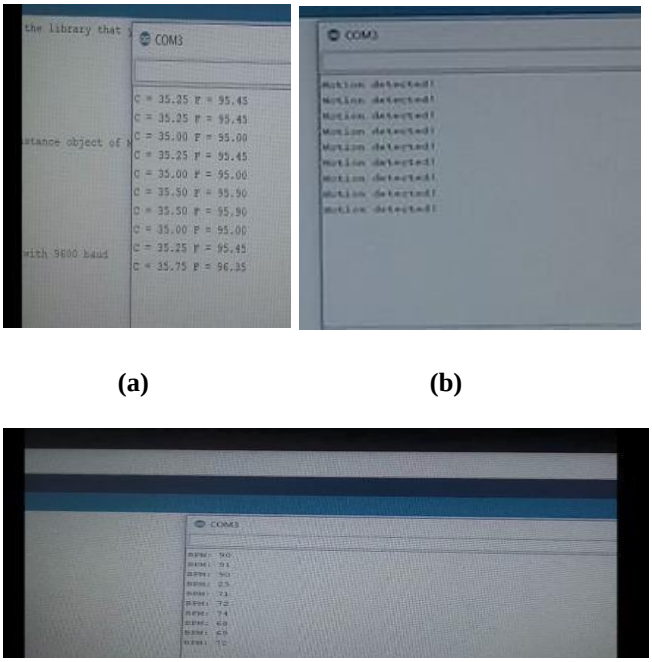
B. To upgrade the existing prototype by integrating blood pressure sensor in it to enhance the peculiarity of ourdesign.

C. To enhance the functionality and accuracy of heart rate sensing by employing ECG (Electrocardiography) sensors to monitor heart rate BPM.

D. Developing a mobile application to make monitoring of individual security personnel more user-friendly.

E. Approaching tactical/civil operation centers for implementation and commercialization of our smart cloth design on a largescale.

XIV. RESULTS:



(a) **(b)**

(c)

Fig: Images of Output obtained from MAX30205(a), PIR sensor(b) and Heart rate sensor(c)

The readings obtained from sensors as shown above are transmitted to the Antares IOT platform via NodeMCU which stores these values on cloud and then deploy on the blockchain after encryption. These details are displayed to the centres through a web app.

Fig: Antares IOT platform

XV. CONCLUSION:

Wearable advances are currently infesting numerous applications in a few fields. The point of this paper is to abridge the genuine savvy attire in the military field where conditions could be basic for wellbeing and security, and diagram the advancement pattern for inventive administrations to security forces and warriors. Also Smart clothes that exist today are expensive because of the use of conductive yarns for providing interwoven circuitry. We believe that our idea of creating smart clothes can be cost efficient and provide precise information about the location and psycho-physiological details of the wearer without compromising security and privacy.

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