Smart Health Monitoring System With GPS

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Abstract- *Technology plays the major role in healthcare not only for sensory devices but also in communication, recording and display device. It is very important to monitor various medical parameters and post operational days. Hence the latest trend in Healthcare communication method using IOT is adapted. Internet of things serves as a catalyst for the healthcare and plays prominent role in wide range of healthcare applications. An Arduino UNO microcontroller board is used for analyzing the inputs from the patient Temperature, heartbeat. The proposed system provides a device which will continuously monitor the vital parameters to be monitored for a patient. If any critical situation arises in a patient, this unit also raises an alarm. This is very useful for future analysis and review of patient's health condition. For more versatile medical applications, this project can be improvised, by incorporating dental sensors and annunciation systems, thereby making it useful in hospitals as a very efficient and dedicated patient care system. In recent years, the world is facing a common problem that the number of elderly people is increasing. Hence, the problem of home-care for elderly people is very important. In this, IoT is becoming a major platform for many services and applications, also using Node MCU not just as a sensor node but also a controller here.*

Keywords- Thing speak, SVM algorithm, Smart Healthcare, IOT Enabled

I. INTRODUCTION

The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings. Likewise, countless ordinary users are being served from the advantages of the M-Health (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health.

According to the constitutions of World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. As we are truly inspired by this, we attempt to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses internet to update the doctors so that they can help in case of any issues at the earliest preventing death rates.

Patient Health monitoring using IoT is a technology to enable monitoring of patients outside of conventional clinical settings (e.g. in the home), which may increase access to care and decrease healthcare delivery costs. This can significantly improve an individual's quality of life. It allows patients to maintain independence, prevent complications, and minimize personal costs. This system facilitates these goals by delivering care right to the home. In addition, patients and their family members feel comfort knowing that they are being monitored and will be supported if a problem arises.

I. LITERATURE SURVEY

[1] AMON: A Wearable Medical Computer for High Risk Patients

Health monitoring is among the most attractive application fields for wearable electronics and has been studied by many research groups. A variety of wearable devices for monitoring physiological parameters are commercially available today (e.g POLAR www.polar-usa.com/) with many others in research and development stage. However the majority of such devices are aimed at the recreational market (e.g joggers) and are not suitable for medical monitoring of high risk patients. Those devices that have been qualified for medical use are usually fairly simple measuring just one or two parameters and providing little or no online analysis. Many are also quite bulky .The AMON (**A**dvanced **M**edical M**on**itor) system is a next generation wearable medical monitoring computer that has been developed by a European Union IST sponsored consortium consisting of 5 industrial partners (Art-of-Technology, Aurelia, Hˆ opitaux de Paris, Tadiran Spectral link), and one academic (wearable Computing Lab ETH Zurich.) It provides complex monitoring,data analysis and communication capabilities in a single wrist worn unit. AMON has been conceived as a clinical device for high risk patients requiring constant monitoring, logging and analysis of their vital signs. Today such patients are severely restricted in their mobility since the required monitoring equipment is either stationary or bulky. With the help of AMON those restrictions will be largely removed.The main innovative features of the AMON system are:

Multi-parameter monitoring and logging system continuously monitors and logs, pulse, blood oxygen saturation and temperature of a patient. It also Prototype of the AMON wearable medical computer (box) and its role in the monitoring system. has an acceleration sensor to indicate the level of physical activity. In addition blood pressure and one lead ECG can be taken whenever necessary. **Online health state analysis**
Using the continuously monitored parameters and user activity information the system performs an online analysis of the user's health status. Should the system decide that the users state deviates from a predefined user specific range, additional measurements including ECG and blood pressure are performed.

Automatic and manual alerts

Should analysis of the additional measurements confirm such deviations,the system can automatically alert a doctor at a remote Medical Center using a built-in mobile phone link. A key advantage of AMON lies in the complexity of the analysis which minimizes the number of false alarms. Of course the system also has a manual alert function that can be user triggered whenever he or she feels that they need help. In whatever case an alert is triggered, all data logged during the previous hours is sent to the medical centre providing doctors with a basis for more accurate diagnosis.

Interactive communication

The system allows medical centre personnel to communicate with the patient using simple on-screen text messages. In addition the medical centre personnel can control the AMON device and instruct it to make new measurements.

Watch-like form

AMON with all its electronics, sensors and a battery sufficient for 24h is contained in a watch-like housing mounted on a wrist worn blood pressure

[2]Ubiquitous Data Accessing Method in IoT-Based Information System for Emergency Medical Services
Advancements in Internet of things (IoT) technologies present enormous potential for the high-quality and more convenient healthcare servicing. By employing these technologies in the activities of healthcare servicing, doctors (managers in medical centres) are able to access different kinds of data resources online quickly and easily, helping to make emergency medical decisions, and reducing costs in the process.

In China, due to the increasing needs of huge population, the different systems between rural and urban health care, the accessibility and availability of medical data, etc., a lack of sufficient information sharing is one of the most basic challenges in healthcare servicing. Much effort has been made in China to solve the problem of clinic data sharing among hospitals.

In Shanghai, integrated clinic information platform has been explored to exchange data among hospital information systems. Resident health document systems have been built in some districts for residents to store and access their electronic medical records in cloud computing environment. These efforts improve the clinic data environment for medical researchers to obtain more patient data conveniently, but it is not enough to support diagnosing, especially in emergency medical services when more data need to be access quickly across organizations to coordinate group activities. Health Level 7 (HL7) provides the application-level standard for clinic data exchanging of network protocol; however, it is still difficult for practicing purpose. In the last decade, a growing number of researches have been conducted toward using IoT Technology to acquire data ubiquitously, process data timely, and distribute data wirelessly in the healthcare field. In, Ambient Assisted Living(AAL) is designed to support daily activities of elderly people independently as long as possible. In , IoT technology is used to support medical consultations among rural patients, health workers, and urban city specialists. With the use of IoT, M-health concept, which is defined as mobile computing, medical sensors, and communication technologies for healthcare, attracts more and more researchers applying fourth-generation (4G) mobile communication technology and IoT in healthcare service.

The above-mentioned uses of IoT technology bring both opportunity and challenges in ubiquitous data accessing medical services. More attentions have been paid in developing ubiquitous data accessing solutions to acquire and process data in decentralized data sources. In , the software adaptation approaches are surveyed in ubiquitous computing for resource on strained devices to react to the changes of user requirements actively and transparently. In, control functionalities are designed to coordinate hybrid wireless networks in cloud computing. In, a metro system based on data-centric middleware is simulated to publish/subscribe message remotely. In, researchers use publish/subscribe-based middleware to disseminate sensor data in cyber-physical systems. A cloud platform is developed in to handle heterogeneous physiological signal data to provide personalized healthcare services. In the related research, clinical data heterogeneity is still the main obstacle that hinders the clinic data integration and interoperation.

Activities and Roles in Medical Services Healthcare service is a dynamic process that mainly includes pre-treatment processing, in-treatment processing, and posttreatment process in. healthcare servicing activities include not only within hospitals but also out of hospitals such as medicine and equipment supplying and insurance document processing. Diverse departments and different kinds of patients, professional staff, physicians, and doctors are involved in the entire health care serving process. Doctors need to access patient data to know medicine-taking history, and these kinds of data can be stored in distributed manner. It may also be needed to access data from the equipment to know busy/free working status and the location to obtain data

Meta Data Model for Ubiquitous IoT Data Accessing Summarizing the features of the medical services, we conclude that the ubiquitous data accessing for IoT data (UDA-IoT)in medical service needs to have the following functions:

1) to support accessing data in heterogeneous formats;
2) to be useful in building real-time application system;
3) to be able to access big data. In order to meet the above-mentioned requirements, we present a unified metadata model to describe IoT notes, in which data are heterogeneous in format,

[3] Application of Virtual Mobile Networking to Real-Time Patient Monitoring

Recent technological advancements in integrated circuits, wireless communications and physiological sensing allow miniature, light-weight, ultra-low batter power ,intelligent monitoring devices. Advances in wireless technologies and communication standards such as ZigBee, 802.15.14 and Bluetooth are making it possible to form sensor networks from separate sensors with greater ease. Utilization of such technology in mobile Wireless Body Area Networks (WBANs)for medical purposes allow for inexpensive, unobtrusive and unsupervised monitoring for patients during their daily activities for prolonged periods of time. These wearable sensors have applications in stroke, physical, myocardial infarction rehabitation as well as traumatic brain injury rehabilitation

WBANs are a mature field of research, where the challenges and applications have been explored for quite some time . One of the most promising applications is the one of healthcare, where wireless sensors are used to monitor patient health statistics and activity If a WBAN is considered as a single network, it is possible to engineer this network into a mobile network. In this way, patients can move between separate access gateways seamlesslyAnd any existing network layer connections can be handed over from one network to the next. The advantages if this being that the patient is more comfortable, no longer encumbered by the multiple wires of these sensors, and physicians will be able to monitor the vital signs of these patients remotely despite them being mobile. Applications of this approach can not only be found in medical care but also in performance sports and gaming. Current research in mobile network mobility is being carried out by the IETF MEXT working group

The benefits of mobile WBANs, especially in medical care can be described as ease of provision, maintenance and management. For provision, physicians will be able to provide the sensors as well as the virtual management module which can be uploaded privately and securely to the patient’s smartphone. The smart phone will then act as a mobile gateway for the remote and local management of the WBAN. The virtual platform offers additional benefits such as increased security and a minimal mobility footprint For maintenance, a virtual management module – a virtual machine image (VMI) – can be backed up easily onto a desktop computer or a remote server. These VMIs can also be migrated onto spare/redundant mobile phones for added robustness, if the a mobile phone fails, for example. VMI scan also be easily modified for unique patient configurations. Having a separate management module also means wireless sensors can be added, removed or configure in real-time.

For management, the mobile WBAN is connected to the wide area network, allowing for real-time management of the WBAN remotely or locally as long as network connectivity is available. A virtual management module for the WBAN also improves the security of any application provided as a third-party VMI as it is effectively sand-boxed at run-time and users can easily restrict access with native file and sensor permissions

WBAN Requirements

Mobile WBANs have a unique set of requirements that should be considered to ensure their successful deployment. Possible requirements such as biosensor design and sensor system design are especially important for our medical scenario. For biosensor design, our scenario needs sterile sensors as the intended target could be someone who is ill or someone who is recovering from illness. Similarly, the not exist today, and we take the position that showing the feasibility of a low-cost, easy-to-use mobile network plat form enabled using a consumer device such as a mobile phone would encourage such a market. Previous Work WBANs have a important role to play in the future of mobile medical care: they have been considered for a number of years for potential healthcare applications. Here is a brief summary specific key points of some projects that are particularly relevant. One of the first areas specific applications targeted has been cardiovascular monitoring (via ECG sensors). Projects such as MCardio Net have developed their Mobile Cardiac Outpatient Telemetry (MCOT) system that enable real-time heartbeat monitoring, focusing on arrhythmias. Cardio Net also allows for integrated analysis and response, as it has an integrated diagnostic and patient management tool. Another potential application is in the realm of first aid responders in disaster recovery situation. AID-N (Advanced Health and Disaster Aid Network) is one such example, its main objective is to allow healthcare providers at disaster scenes and medical professionals within remote hospitals the ability to consult specialists who are geographically distant, on patient issues. Patients wear motes (MICAZ), which records their vital signs and transmits the data central database. Nodes within an area form a wireless ad hoc network along with an onsite portable tablet PC which acts as a hub. AMON is a similar system that looks a patients with cardiac and respiratory problems, it works in the same way through wrist worn sensors, with continuous data collection and evaluation of multiple vital signs. The usage of sensors in a WBAN usually calls for a transit/relay device that acts as a data sink and also as a router to the outside world. Usually portable tablet PC or more recently smart phones are used in this way. Health Gear and Moby health are two such examples. Health Gear uses Bluetooth to form an ad hoc wireless network between its sensors and cellphone. The cell phone stores, transmits and analyses the data and presents it to the phone user. Mob health was developed for the continuous monitoring of patient outside of the hospital environment. It proposes to integrate sensors and actuators to form a wireless BAN. Mobile althea further to leverage Smartphone connectivity to push data online. One of the purposes of the project was to test the ability of 2.5G/3G infrastructures to support value-added health care services. Another important aspect of WBANs is the placement of the sensor, one novel approach has been to embed the sensors with clothing, some examples of this are Lifeguard monitoring system, Health Gear, Wearable BAN and Life Shirt Life shirt has the additional ability to share information with peripheral devices and incorporate patient input, this is then collected via a PDA and transmitted online. There are also projects which go further and try to integrate WBANs on a larger scale. The Code Blue project looks at building an entire wireless infrastructure to support sensing via the WBANs. The BASUMA Project is another such project that focuses on multimedia applications. The My Heart Project aims to integrate sensing into the average person’

[4] Plug 'n Play Simplicity for Wireless Medical Body Sensors

Wireless body area networks (WBANs) are an enabling technology for the application domain of unobtrusive medical monitoring. This field includes continuous cable-free monitoring of vital signs in hospitals, remote monitoring of chronically ill patient, monitoring of patients in mass casualty situations, monitoring people in their everyday lives to provide early detection and intervention for various types of disease, computer-assisted physical rehabilitation in ambulatory settings, and assisted living of elderly at home A wireless. A body sensor network consists of smart wireless medical sensors measuring for example ECG, non-invasive

There are several options how to realize a system based on body-coupled communication. In the mid nineties Zimmerman started with a Personal Area Network (PAN) based on what he called 'intra-bod communication' (IBC). He described a network of wireless devices that communicate by intra-body data. A PAN prototype working at 330kHz with a data rate of about 2.4kBit/s was developed to demonstrate the digital exchange of data through the body. Gray modeled the system and its channel capacity. These two Master Theses were used as the primary source of information on intra-body technology.

[5]A Wireless Biomedical Signal Interface System-on-Chip for Body Sensor Networks

The ability to integrate complete sensor systems into a very small form factor is of growing importance as applications, such as ubiquitous computing , micro total analytical-systems (TAS), wearable electronics, and body sensor networks (BSN), become more widespread. One of the earliest examples of these technologies was demonstrated by Mackay in 1961. An important aspect of Mackay’s work was that his device was made possible by the then relatively recent invention of the transistor. More recent developments have sought to make use of recent technological developments. Examples are the development of Smart dust that uses microelectromechanical systems technology to explore the extremes of miniaturization, microdot biotics for gastrointestinal investigation and other sophisticated BSNs using discrete electronics components-based devices . Quite often, the relative large Man script received January 31, 2009; revised May 18, 2009. Current version

Sensor Interfaces

The SOC operates with external pH (acidity/alkalinity) and temperature sensors. The pH sensor used here is an ion- sensitive field-effect transistor (ISFET) and has a Nernstian response with respect to pH. Unfortunately, this device also has aresponse to temperature change that must be calibrated for. Asa consequence, the temperature sensor is not only required to provide a temperature reading per se, but is also required tenable calibration of the pH sensor. The external temperature sensor is a forward biased pin junction with a junction area
0.6 mm . The interface circuit is a conventional structure that connects the diode in feedback across an operational amplifier with a constant bias current. An on-chip bias resistor sets the constant current to be approximately 15 A. saturation current of the diode is 30 Pa and the ideality factor is approximately 2; therefore, the device sensitivity 22 C, but does vary from device to device due to tolerances. The external pH-ISFET sensor forms the load of a 33- A cascode current sink. The ISFET is similar to a MOSFET device where the gate metal was replaced by a reference electrode immersed. The ISFET has an intrinsic gate referred sensitivity of a 43-mV/pH point. For circuit implementation, the cascade structure of the current source allowed a high impedance to be obtained, which reduced the variations of the drain-source current due to the fabrication, temperature and power-supply variations. The output transistors of the cascade circuit form an active load to the ISFET that is configure edams a source follower; thus, the voltage swing at the source of theist responds at the 43-mV/pH point.

Mixed-Signal System Platform

and a 10-b successive approximation analog-to-digital converter (ADC). Power supplies were directly connected as the reference voltages of the ADC. The microcontroller-driven multiplexers allow eight sensor channels to be presented to a single ADC for 0.3 ms each, hence,2.4 MS is required to sample all eight channels However, the system sample rate was set to be approximately 0.5 S/s, by which we mean all eight channels are sampled once every 2 In order to minimize the off chip component count, hence, the overall packaged system size, we used an on-chip RC relaxation oscillator to generate the input to the chip timer circuit. The first-order relaxation oscillator was based on charging The analog-to-digital interface circuitry comprises seven 2-input multiplexor discharging an on-chip timing capacitor via a precision current source, which provided a cost-effective solution as well as design simplicity and programmable ability. The oscillation frequency of the relaxation oscillator was proportional to the value of the charging current and was inversely proportional to the value of the timing capacitor. The relaxation oscillator circuit was designated with an operational transconductance amplifier, a comparator, an inverter, the sampling switches and capacitor, and a controlled current source. The relaxation oscillator has an automatic swing control loop to rectify the oscillation amplitude adaptively in ordered to provide symmetrical oscillation waveforms. The timing precision of the oscillator is poor due to the fabrication tolerance of on- chip resistors and capacitors, but this imprecision is not important in the context of the complete system The nominal frequency of the RC oscillator is set to be8 MHz, but it measures only 7.1 0.1 MHz on a batch of ten fabricated chips. The timer circuit contains a digital divider designed to generate different clocks for the ADC (250 kHz), the microcontroller (250 kHz), and the data encoder (32 kHz). The clock rates for these blocks are 224 kHz, 224 kHz, and 29 kHz respectively because of the shift of the nominal oscillator frequency. The timer can generate the originally intended clock frequencies when it is connected to an oscillator implemented in the RF section of the SOC, but this requires an additional off-chip surface-acoustic-wave (SAW) resonator and two resistors. However, in order to save power, the RF oscillator is not used for timing, but only when wireless transmission is required). In addition to generating the system clocks ,the timer also generates a positive pulse (lasting 5s) every two seconds to start the microcontroller. The microcontroller was designed by us to have the identical instruction set, excluding the multiply (MUL) and WAIT instructions, as a Motorola 6805 CPU. The microcontroller was designed to be fully static and was implemented with 512-BROM, 32-B RAM (24 B for buffers and 8 B for stack), three bidirectional 8-b input/output (I/O) ports and a 16-b capture/compare timer system. The software routines, embedded into the512-B ROM, were used for scheduling different tasks, such as channel cycling, data sampling and packet forming, and automatically go into a sleep mode when all tasks are finished. However, every two seconds, the aforementioned positive pulse generated by the timer invokes a rising-level sensitive interrupt of the microcontroller, and forces the microcontroller to go back town active mode. This external interrupt design enables

III. EXISTING SYSTEM

Health monitoring is the major problem in today’s world. Due to lack of proper health monitoring, patient suffer from serious health issues. There are lots of IoT devices now days to monitor the health of patient over internet. Health experts are also taking advantage of these smart devices to keep an eye on their patients. With tons of new healthcare technology start-ups, IoT is rapidly revolutionizing the healthcare industry. Here in this project, we will make an IoT based Health Monitoring System which records the patient heart beat rate and body temperature and also send an email/SMS alert whenever those readings goes beyond critical values. Pulse rate and body temperature readings are recorded over ThingSpeak and Google sheets so that patient health can be monitored from anywhere in the world over internet.

Health is the most important part of any human's life without health it is useless to any treasure of life. Most humans live a busy life in which going to a doctor for weekly or even monthly check-up is an impossible task. Without monitoring your health it is not possible to whether you are a healthy or sick person. This problem leads to the design of a product which monitors your health every day without going to a doctor. In this paper, a system is designed as a prototype for monitoring alerting based on the health of a person. This system is fully automated little or no human help is needed. Any doctor can monitor this person from anywhere through the internet.

DRAWBACKS

1)Diagnosing with help of a doctor.2)Conventional devices that can only measure a particular parameter.3)Devices that have to be connected invasively to get measurements.4)No automated system exists.5)Smart watches are expensive and not specifically for healthcare

IV. PROPOSED SYSTEM

Cloud computing and Internet of Things (IOT) are two technologies which though not directly related have a significant role in our day to day living. These two technologies can be merged together to solve problems in domains of healthcare, surveillance, assisted living, agriculture, asset tracking. However, Cloud computing is not an ideal choice for applications that require real time responses due to high network latency. Hence a new technique "edge computing" was introduced that would push the computation to the "edge of the network" thereby reducing network latencies. Edge computing can address concerns involving real time responses, battery power consumption, bandwidth cost as well as data safety and privacy. In this paper we shall consider the applications of edge computing and IOT in the field of healthcare. In this research especially, we are exploring the possibilities of integration of cloud/edge computing and Machine Learning paradigms into a Distributed computing based IOT Framework. The target is to able to extract relevant information of interest among the huge data that is typically generated by the front- end Sensor frameworks in IOT devices. Some intelligence can be included in the front-end module itself to enable the front-end to take a decision on data priority. Guidance regarding how to achieve this can be provided by a backend IOT server. It is proposed that the backend server has Machine Learning based implementations to be able to automatically learn data signatures of interest based on the data it has already received.

Fig 4.1 Block diagram

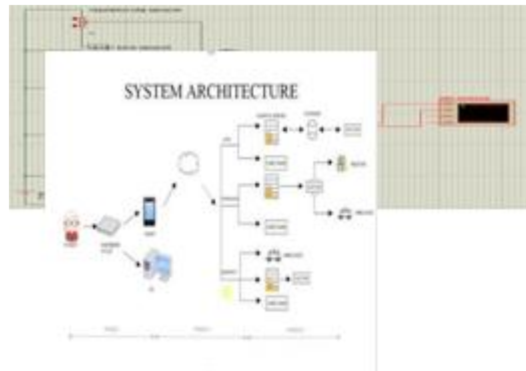


Fig 4.2 System architecture

IoT (Internet of Things) is a framework that uses technologies like sensors, network communication, artificial intelligence and bigdata to provide real life solutions. These solutions and systems are designed for optimal control and performance. Internet of Things (IOT) is a happening Technology given the advancements in allied technologies like Sensor, Communication and Computing. With these advancements, any leaf node device of today is capable of "sensing" its surroundings, can perform computation and is addressable by a network address over a wireless network. This enables solutions to be developed that can map "real life" entities to a corresponding virtual object. These virtual objects can communicate with each using available communication technologies and keep the "real life" entity informed about the state of "things". A control mechanism between the "real life" entities and the virtual objects is also included as part of this framework/solution.

Cloud computing comprises topics related to providing computing services and utilities like servers, storage, databases, networking, software, analytics etc over the internet. Depending on the requirements of the end user, various services can be provided from a remote location. Edge computing is a subset of cloud computing where multitude of these services are provided from a location that is geographically closure to the end user and can thereby serve the purpose of eliminating network latency. A typical IOT model comprises an end node device that can communicate with a back-end computation/data center over a communication medium (Generally Wireless). The communication channel mostly uses IOT protocols like MQTT/CoAP. Data and Control Messages can be seamlessly exchanged across the IOT endpoint and a Data Center Server. The Endpoint device can provide ambient condition information to a Data Centre using various Sensors depending on the domain of interest and get back information/instructions from backend to perform actions. The Back-End Servers are generally powerful computing resources and can use computation intensive algorithms to process the data gathered from the End point devices.

The main challenges around IOT solutions are

The amount of data generated by the sensors are huge. Extraction of relevant information from the captured data is a challenge. This effort requires development of an algorithm that can extract abnormalities in captured data for body sensor networks. There have major research scopes in field of machine learning and sampling algorithms

Given the fact that computation intensive operations are pushed to back end, optimization of Real Time Response is an area of improvement.

Optimizing the amount of data transfer is an area of interest. Decentralization of computation. With more and more devices being IOT capable, computation at one point will create bottleneck in network resources. The computation needs to be distributed and Task Level Parallelism needs to be achieved. Computation and resource distribution algorithms are areas of major research interest in this field Security of the IOT devices.

Power Consumption at End Point Devices. Battery consumption is one of the major concern in IOT devices as charging these devices may not be an easy affair. This problem is generally solved by offloading tasks to a back-end server and saving battery power that would have been otherwise required for in-house computing. This provided a major impetus to research in the domains of decentralization of computation

Edge computing facilitates network response times, aids decentralization and can also address security concerns. This is because a large part of the critical computation can now be performed at the "edge nodes" which would interact with cloud periodically. This provides the facilities of cloud computing sans its disadvantages. Coupled with Machine learning and Big data tools, high efficacy real time solutions can be developed. In this research, we are exploring the ossibilities of integration of cloud/edge computing anMachine Learning paradigms into a Distributed computing based IOT Framework. The target is to able to extract relevant information of interest among the huge data that is typically generated by the front- end Sensor frameworks in IOT devices. Some intelligence can be included in the front-end module itself to enable the front-end to take a decision on data priority. Guidance regarding how to achieve this can be provided by a backend IOT server. It is proposed that the backend server hasMachine Learning based implementations to be able to automatically learn data signatures of interest based on the data it has already received.

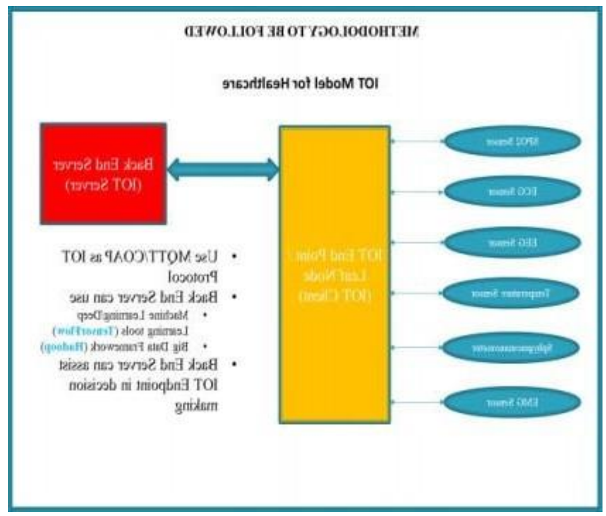


Fig 4.3 IOT Model of Healthcare SVM ALGORITHM

"Support Vector Machine" (SVM) is a supervised machine learning algorithm which can be used for both classification or regression challenges. However, it is mostly used in classification problems. In this algorithm, we plot each data item as a point in n- dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiate the two classes. Support Vectors are simply the co-ordinates of individual observation. Support Vector Machine is a frontier which best segregates the two classes (hyper-plane/ line).

1.Identify the right hyper-plane (Scenario-1): Here, we have three hyper-planes (A, B and C). Now, identify the right hyper-plane to classify star and circle.

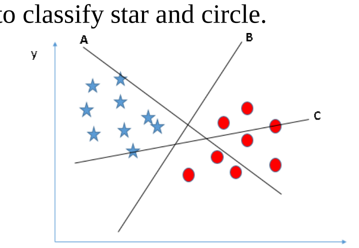


Fig. 4.5 Hyper-plane (Scenario-1)

The thumb rule to identify the right hyper-plane: "Select the hyper-plane which segregates the two classes better". In this scenario, hyper-plane "B" has excellently performed this job.

1.Identify the right hyper-plane (Scenario-2): Here, we have three hyper-planes (A, B and C) and all are segregating the classes well. Now, How can we identify the right hyper-plane?

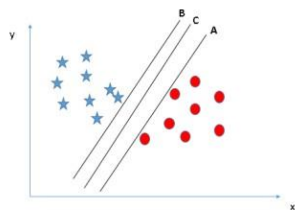


Fig 4.6 Hyper-plane (Scenario-2)

Here, maximizing the distances between nearest data point (either class) and hyper-plane will help us to decide the right hyper-plane. This distance is called as **Margin**. Let's look at the below snaps

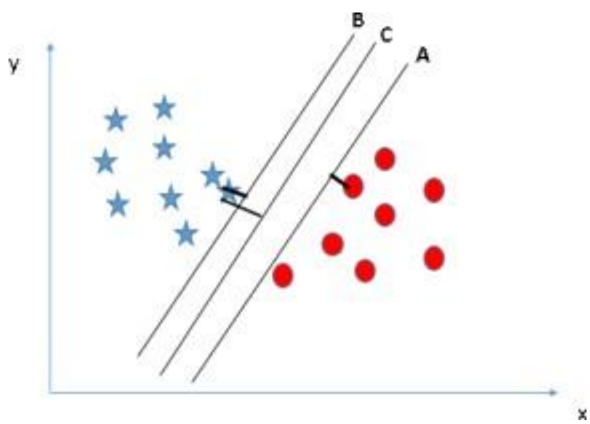


Fig 4.7 Hyper-plane-Margin

Above, you can see that the margin for hyper-plane C is high as compared to both A and B. Hence, we name the right hyper-plane as C. Another lightning reason for selecting the hyper-plane with higher margin is robustness. If we select a hyper- plane having low margin then there is high chance of miss- classification.

1.Identify the right hyper-plane (Scenario-3): Hint: Use the rules as discussed in previous section to identify the right hyper-plane

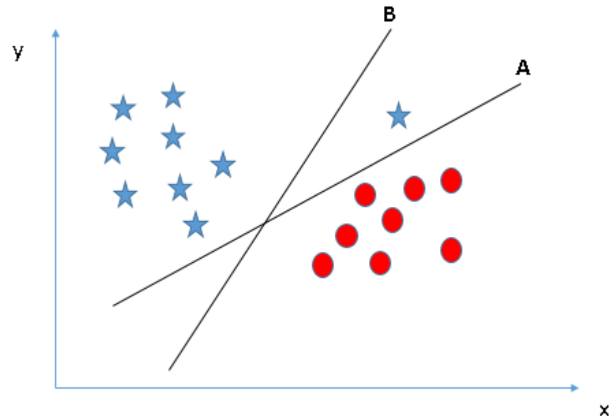


Fig 4.8 Hyper-plane (Scenario-3)

Some of you may have selected the hyper-plane **B** as it has higher margin compared to **A.** But, here is the catch, SVM selects the hyper-plane which classifies the classes accurately prior to maximizing margin. Here, hyper-plane B has a classification error and A has classified all correctly. Therefore, the right hyper-plane is **A.**

Can we classify two classes (Scenario-4)?: Below, I am unable to segregate the two classes using a straight line, as one of star lies in the territory of other(circle) class as an outlier.

Fig 4.9 Hyper-plane (Scenario-4)

As I have already mentioned, one star at other end is like an outlier for star class. SVM has a feature to ignore outliers and find the hyper-plane that has maximum margin. Hence, we can say, SVM is robust to outliers.

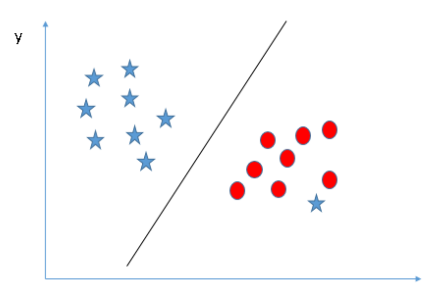


Fig 4.10 Hyper-plane- Outliers

Find the hyper-plane to segregate to classes (Scenario-5): In the scenario below, we can't have linear hyper-plane between the two classes, so how does SVM classify these two classes? Till now, we have only looked at the linear hyper-plane.

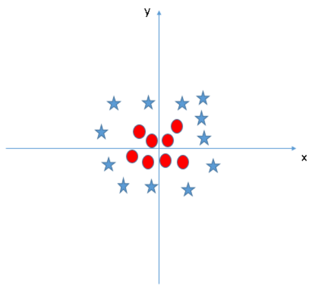
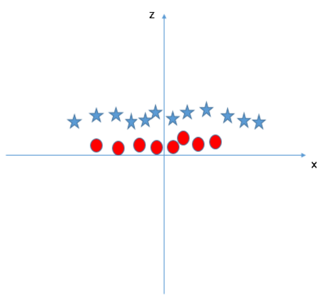


Fig 4.11 Hyper-plane (Scenario-5)

SVM can solve this problem. Easily! It solves this problem by introducing additional feature. Here, we will add a new feature z=x^2+y^2. Now, let's plot the data points on axis x and z:



In SVM, it is easy to have a linear hyper-plane between these two classes. But, another burning question which arises is, should we need to add this feature manually to have a hyper-plane. No, SVM has a technique called the kernel trick**.** These are functions which takes low dimensional input space and transform it to a higher dimensional space i.e. it converts not separable problem to separable problem, these functions are called kernels. It is mostly useful in non-linear separation problem. Simply put, it does some extremely complex data transformations, then find out the process to separate the data based on the labels or outputs you've defined.

V. INTERNET OF THINGS-HEALTHCARE

Research in related fields has shown that remote health monitoring is plausible, but perhaps more important are the benefits it could provide in different contexts. Remote health monitoring could be used to monitor non-critical patients at home rather than in hospital, reducing strain on hospital resources such as doctors and beds. It could be used to provide better access to healthcare for those living in rural areas, or to enable elderly people to live independently at home for longer. Essentially, it can improve access to healthcare resources whilst reducing strain on healthcare systems, and can give people better control over their own health at all times. In fact, there are relatively few disadvantages of remote health monitoring. The most significant disadvantages include the security risk that comes with having large amounts of sensitive data stored in a single database, the potential need to regularly have an individual's sensors recalibrated to ensure that they're monitoring accurately, and possible disconnections from healthcare services if the patient was out of cellular range or their devices ran out of battery. Fortunately, these issues are all largely solvable, and are already being addressed in the literature, as will be highlighted throughout the remainder of this paper. As progress continues to be made to reduce the disadvantages, IoT-based systems for remote health monitoring are becoming an increasingly viable solution for the provision of healthcare in the near future. As a result of the many benefits of remote health monitoring, many recent researchers have identified the potential of the Internet of Things as a solution for healthcare. In several works, IoT healthcare systems have been developed for specific purposes, including rehabilitation, diabetes management, assisted ambient living (AAL) for elderly persons, and more. While these systems have been designed for many different purposes, they are each strongly related through their use of similar enabling technologies. Rehabilitation after physical injury has been a topic of particular interest for several researchers. In [7], a system has been developed that generates a rehabilitation plan tailored to an individual based on their symptoms. The patient's condition is compared with a database of previous patients' symptoms, ailments, and treatments to achieve this. The system requires a doctor to manually enter symptoms, and approve the recommended treatment; in 87.9% of cases, the doctor agreed completely with the system, and no modifications were made to the treatment plan it proposed. Mathematical models for the measurement of joint angles in physical hydrotherapy systems are proposed, enabling the improvement of joint movement to be tracked through therapy. In [6], existing IoT technologies are evaluated for their usefulness in a system for monitoring patients suffering from Parkinson's Disease. Their work concludes that wearable sensors for observing gait patterns, tremors, and general activity levels could be used in combination with vision-based technologies (i.e. cameras) around the home to monitor progression of Parkinson's Disease. Furthermore, the authors suggest that machine learning could lead to enhanced treatment plans in the future.

A practical system for the monitoring of blood-glucose levels in diabetic patients was proposed in [5]. This system requires patients to manually take blood-glucose readings at set intervals. It thereafter considers two kinds of blood glucose abnormalities. The first is abnormal blood-glucose levels and the second is a missed blood-glucose reading. The system then analyses the severity of the abnormality, and decides who to notify; the patient themselves, caregivers and family members, or emergency healthcare providers such as doctors. This system is practical and has been proven realizable, though could be further improved by automating blood- glucose measurements. A system aimed at detecting heart attacks was built using ready-made components and a custom antenna. An ECG sensor is used to measure heart activity, which is processed by a microcontroller. This information is forwarded via Bluetooth to the user's smartphone, where the ECG data is further processed and is presented in a user application. The authors identify that developing heart attack prediction software would improve the system. Further improvements could be made by measuring respiratory rate, which is known to aid in the prediction of heart attack .

MODEL

Wearable Sensor & Central Nodes

Wearable sensor nodes are those that measure physiological conditions. Recommended sensors are those that measure the vital signs - pulse, respiratory rate, and body temperature - as these are the essential signs for determination of critical health. Further sensors that could be implemented are blood pressure and blood oxygen sensors, as these parameters are often taken alongside the three vital signs. Special-purpose sensors such as blood-glucose, fall detection, and joint angle sensors could also be implemented for systems targeting a specific condition. The central node receives data from the sensor nodes. It processes this information, may implement some decision making, and then forwards the information to an external location. A dedicated central node would be preferred to a smartphone as battery life could be improved by having only functionality relevant to a healthcare IoT system.

Short-Range Communications

For sensors to communicate with the central node, a shortrange communications method is required. There are several important requirements to consider when choosing a short-range communications standard, including effects on the human body, security, and latency. The chosen method should have no negative effects on the human body, as any such effects could cause additional health concerns for patients. It should also provide strong security mechanisms to ensure that sensitive patient data cannot be accessed by an attacker. Finally, low-latency is essential for time-critical systems, such as a system that monitors critical health and calls for an ambulance if the need arises. In such systems, time delays could be the difference between life and death. In applications that are not time-critical, lowlatency would not need to be prioritized as highly, but is still preferable.

Long-Range Communications

Data obtained by the central node is not useful unless something can be done with it. This data should be forwarded to a database where relevant parties (such as caretakers or doctors) can securely access it. There are again several considerations when selecting a suitable long-range communications standard for use in a healthcare system, including security, error correcting capabilities, robustness against interference, low-latency, and high availability. As with short-range communications, strong security is important to ensure that sensitive patient data remains private and cannot be altered or imitated. Low-latency is again important in time-critical applications, such as emergency healthcare, where delays in communication could have detrimental effects on patients. High-quality error correcting capabilities and significant robustness against interference are essential, as these ensure that the message sent is the same as the message received. This is important in all healthcare applications, but particularly in emergency situations. Lastly, high availability is essential to ensure that messages will be delivered at all times, regardless of where the patient is physically located. Again, this is of particular importance to time-critical applications, but is preferable for all systems.

Secure Cloud Storage Architecture & Machine Learning

Medical information obtained from patients must be stored securely for continued use. Doctors benefit from knowing a patient's medical history, and machine learning is not effective unless large databases of information are available to it. Based on the literature, cloud storage is the most viable method for storing data. However, providing accessibility for healthcare professionals without compromising security is a key concern that should be addressed by researchers developing healthcare IoT systems. Additionally, machine learning has repeatedly been identified in the literature as a means for improving healthcare systems [4], [6], [7], though it has not been widely explored. Machine learning offers the potential to identify trends in medical data that were previously unknown, provide treatment plans and diagnostics, and give recommendations to healthcare professionals that are specific to individual patients. As such, cloud storage architectures should be designed to support the implementation of machine learning on big data sets.

Wearable Healthcare Systems

Wbans have been identified as a key component of a healthcare system founded on Internet of Things technology, and as such the development of accurate sensors with low form factor are essential for the successful development of such a system. In this article, we focus on sensors that are non-obtrusive and non-invasive; we exclude sensors such as implantable. Considered are five fundamental sensors - three for monitoring the vital signs of pulse, respiratory rate, and body temperature, and a further two for monitoring blood pressure and blood oxygen, both commonly recorded in a hospital environment.

Machine Learning

Machine learning uses algorithms to find patterns in data, and then uses a model that recognizes those patterns to make predictions on new data.

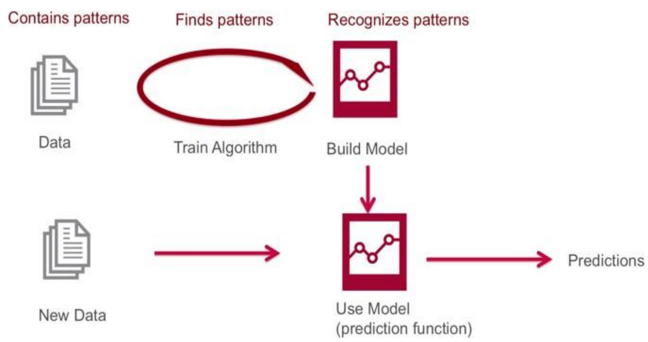


Fig 5.1 Machine Learning

VI. HARDWARE DESCRIPTION

Arduino

Smart phone with android operating system is used to control the motion and navigation of the wheelchair, to send the message to the helper and to automate the home appliances using same application. A smart phone with Android Operating System, which is widely used everywhere can be used to run the application. The smart phone has inbuilt accelerometer to control the movement of the wheelchair. So there are two ways we can control navigation one with keys and on with accelerometer. The person can send message to the for help regarding washroom, food etc. The mobile phone's inbuilt Bluetooth is linked to an external Bluetooth module which is further connected to the relays via Arduino which control the home appli-ances like fan, lights etc. The wheelchair also has a GPS module to track the current position of Wheelchair and to automate the path of the wheelchair.

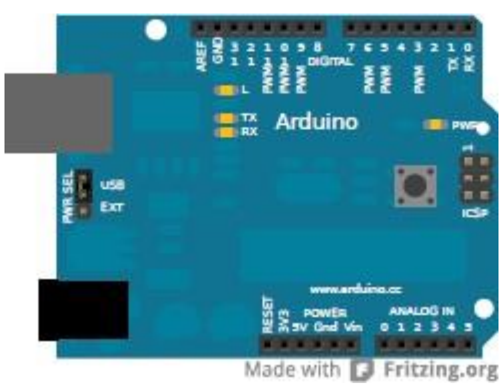
Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes even more difficult for people with arms or hands impairments. Some patients who cannot manipulate the direction of the wheelchair with their arms due to a lack of force face major problems such as orientation, mobility etc. Therefore the Robotic wheel Chair is developed to overcome the above problems allowing the end-user to just perform safe movements and accomplish some daily life important tasks. This is a dual input type operated wheel chair that is made to work based on voice and touch screen commands. Since the motorized wheelchair can move at a fair speed, it is important to control the speed of the wheel chair as per the end-user requirement. Thus the speed of the motors is controlled by using PWM method. The voice recognition is done by HM2007 voice recognition IC. The microphone is directly connected at the analog input of voice recognition IC HM2007 keeping the mode selection key in the record mode. The microcontroller ATMEGA8 along with motor driver L293D is used to drive and control the two DC motors. As it is a dual input type the system is designed such that based on the switch state the input is selected.Android mobile phone is used to control the motion of the wheelchair, to send the message to the helper and to control the home appliances. A smart phone powered with Android Operating System, which is widely used everywhere can be used to run the application. The smart phone has been made smarter by using its inbuilt accelerometer to control the movement of the wheelchair. The person can send message to the helper for help regarding washroom, tea, food etc. The mobile's bluetooth is linked to an external bluetooth which is further connected to the relays via Arduino which control the home appliances like fan, lights etc. The wheelchair powered with two brushless DC motors operating at 48 volts can also be monitored by a battery level indicator circuit up to 10 levels. Patients involved in physical injuries and disabilities with good mental strength struggle to get through places using the conventional hand powered wheelchair. This paper enables an economic assembly in any existing wheelchair that enables a smart system for automated motion which can be controlled by any Smartphone. The main concept involved is „Smartphone" which has an operating system as Android which have inbuilt 3 axis accelerometer and Bluetooth Wireless technology [1]. The purpose of our project can be extended to other mobile devices which has Android powered mobile phone by sharing the application that we have developed. The main second part of our system architecture has a microcontroller PIC16F877 which drives the various directions of the dc motor for directional movement of wheelchair and powers the DC motor for linear motion of the wheelchair [2]. The DC motor controls the front wheels for

turning the wheelchair while the pair of DC motor connected to the rear wheels enable linear motion. With the increase of elderly and disabled people, a wide range of support devices and modern equipment has been developed to help improve their quality of life. Some patients which cannot manipulate the wheelchair with their arms due to a lack of force face major problems such as orientation, mobility, safety [5] .
There are various kinds of wheelchair which are being manufactured such as

1) Manual or self propelled wheelchair-It is normal chair
2) Speech Recognition-It recognizes the verbal command given by patient and according to that wheelchair moves.
3) Image acquisition-It uses camera to detect hand movement and according to it movement occurs.
4) Sensor controlled- In this sensors like accelerometer sensor and flex sensor. As a stability point of view it is quite good but it require high accuracy while designing and programming.

Microcontroller

A micro-controller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/ output peripherals The important part for us is that a micro-controller contains the processor (which all computers have) and memory, and some input/output pins that you can control. (often called GPIO –



General Purpose Input Output Pins). Fig 6.1 Micro-controller

We will be using the Arduino Uno board. This combines a micro-controller along with all of the extras to make it easy for you to build and debug your projects. The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

This is a relatively easy way to make circuits quickly. Breadboards are made for doing quick experiments. They are not known for keeping circuits together for a long time. When you are ready to make a project that you want to stay around for a while, you should consider an alternative method such as wire-wrapping or soldering or even making a printed circuit board (PCB). The first thing you should notice about the breadboard is all of the holes. These are broken up into 2 sets of columns and a set of rows (the rows are divided in the middle). The columns are named a, b, c, d, e, f, g, h, i, and j (from left to right). The rows are numbered 1 - 30. (from top to bottom). The columns on the edges do not have letters or numbers. The columns on the edges are connected from top to bottom inside of the breadboard to make it easy to supply power and ground. (You can think of ground as the negative side of a battery and the power as the positive side.) For this book our power will be +5 volts. Inside of the breadboard, the holes in each row are connected up to the break in the middle of the board.

Programming

The Uno can be programmed with the Arduino Software (IDE). Select "Arduino/Genuino Uno" from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Uno comes preprogrammed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar; see these instructions for details. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the

Arduino repository. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

1)On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. 2)On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

Power

The Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center- positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows :

Vin. The input voltage to the Uno board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You cansupply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.3)3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.4)GND. Ground pins.IOREF: This pin on the Uno board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.In addition, some pins have specialized functions :Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip. External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details. PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function. SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library .LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. AREF. Reference voltage for the analog inputs. Used with analogReference(). Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

The Uno has a number of facilities for communicating with a computer, another Uno board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1. A Software Serial library allows serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use he SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano infarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

Physical Characteristics

The maximum length and width of the Uno PCB are 2.7 and 1.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

SENSORS

Temperature Sensor:

Fig 6.2 LM 35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO- 220 package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 f 1 mA load

Blood Pressure Sensor:

Fig 6.3 BP Sensor

When a positive pressure is applied to an ICP pressure sensor, the sensor yields a positive voltage. The polarity of PCB charge mode pressure sensors is the opposite: when a positive pressure is applied, the sensor yields a negative output. Charge output sensors are usually used with external charge amplifiers that invert the signal. The resulting system output polarity of a charge output sensor used with a charge amplifier produces an output that is the same as an ICP sensor. Reverse polarity sensors are also available.

Most PCB piezoelectric pressure sensors are constructed with either compression mode quartz crystals preloaded in a rigid housing or unconstrained tourmaline crystals. These designs give the sensors microsecond response times and resonant frequencies in the hundreds of kilohertz, with minimal overshoot or ringing. The mechanical structure of the pressure sensor will impose a high frequency limit. The sensitivity begins to rise rapidly as the natural frequency of the sensor is approached. The increase in sensitivity is illustrated.

Heartrate Sensor

The sensor consists of a light source and photodetector; light is shone through the tissues and variation in blood volume alters the amount of light falling on the detector. The source and detector can be mounted side by side to look at changes in reflected light or on either side of a finger or earlobe to detect changes in transmitted light. The particular arrangement here uses a wooden clothes peg to hold an infra red light emitting diode and a matched phototransistor. The infra-red filter of the phototransistor reduces interference from fluorescent lights, which have a large AC component in their output.

ECG Sensor

Fig 6.5 ECG Sensor

ECG records the electrical activity generated by heart muscle depolarizations, which propagate in pulsating electrical waves towards the skin. Although the electricity amount is in fact very small, it can be picked up reliably with ECG electrodes attached to the skin (in microvolts).The full ECG setup comprises at least four electrodes which are placed on the chest or at the four extremities according to standard nomenclature (RA = right arm; LA = left arm; RL = right leg; LL = left leg). Of course, variations of this setup exist in order to allow more flexible and less intrusive recordings, for example, by attaching the electrodes to the forearms and legs. ECG electrodes are typically wet sensors, requiring the use of a conductive gel to increase conductivity between skin and electrodes.

SPO2 Sensor

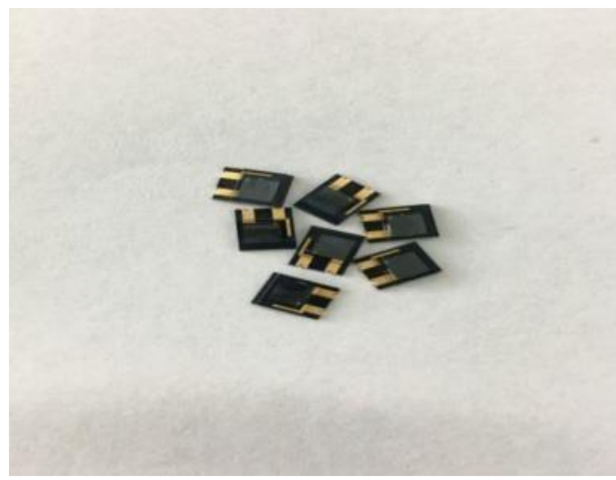


Fig 6.6 SPO2 Sensor

SpO2 is measured at the periphery, usually a finger, and is one measure of the health of the cardiovascular and respiration systems. A pulse oximeter noninvasively measures the oxygen saturation of a patient’s blood. This device consists of a red and an infrared light source, photo detectors, and a probe to transmit light through a translucent, pulsating arterial bed, typically a fingertip or earlobe. Oxygenated haemoglobin (O2Hb) and deoxygenated haemoglobin (HHb) absorb red and infrared light differently. The percentage of saturation of haemoglobin in arterial blood can be calculated by measuring light absorption changes caused by arterial blood flow pulsations.

A variety of factors can affect the accuracy of SPO2 measurement, including skin conditions, pigment, wounds, scar tissue, tattoos, nail polish, hypothermia, anaemia, medication, light interference, and movement.

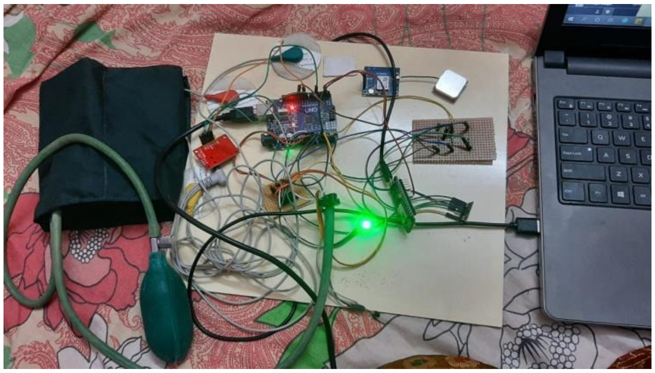
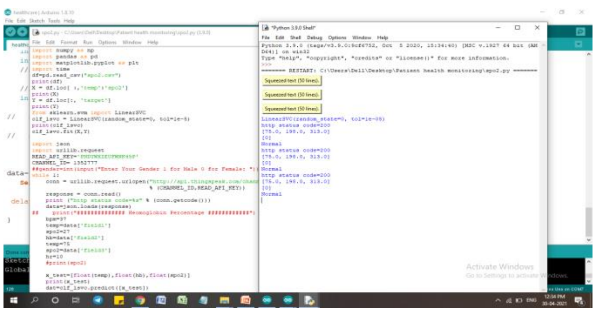
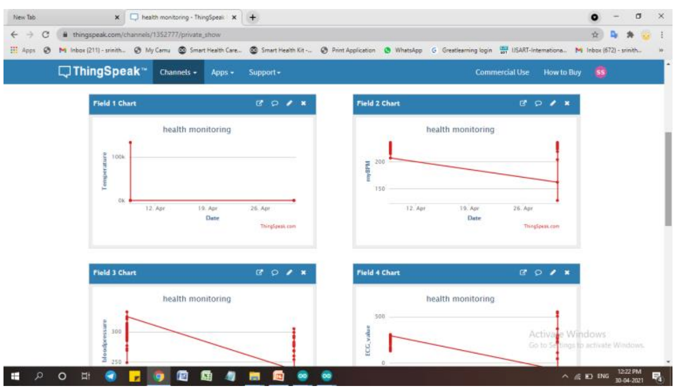


Fig 6.7 Integrated sensors

VII. FINAL OUTPUT





VIII. CONCLUSION

In this paper, we present an IoT network system for connected health and safety applications for industrial outdoor workplace. The system is able to monitor both physiological and environmental data forming a network from wearable sensors attached to workers' body and provide invaluable information to the system operator and workers for safety and health monitoring. Aspects such as sensor node hardware and software design, gateway and cloud implementation are discussed. In our future works, different environmental and physiological sensors can be integrated to the system to suit different workplaces. A smartphone-based IoT gateway can be developed to reduce the dependency of the fixed location

REFERENCES

[1] Data Management for the Internet of Things: Design Primitives and Solution by Mervat Abu- Elkheir. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC 3871070/

[2] IEEE Communications Society:Edge Computing for the Internet of Things http://www.comsoc.org/netmag/cfp/edge-computing-internet-things

[3] Edge cloud computing technologies for internet of things:A primer http://www.sciencedirect.com/science/article/pii/S2352 864817301335

[4] Joint Computation Offloading and Interference Management in Wireless Cellular Networks with Mobile Edge Computing by Chenmeng Wang, F. Richard Yu, Chengchao Liang, Qianbin Chen, Lun Tang, IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY Page 7432 - 7445, VOL. 66, NO. 8, August 2017

[5] Mobile Edge Computing: A Survey on Architecture and Computation Offloading by Pavel Mach and ZdenekBecvar IEEE COMMUNICATIONS SURVEYS & TUTORIALS Page 1628 - 1656, VOL. 19, NO. 3, THIRD QUARTER 2017

[6] Offloading in Mobile Edge Computing: Task Allocation and Computational Frequency Scaling by Thinh Quang Dinh, Jianhua Tang, Quang Duy La, Tony Q. S. Quek, IEEE TRANSACTIONS ON COMMUNICATIONS Page 3571 - 3584, VOL. 65, NO. 8, August 17

[7] On Multi-Access Edge Computing: A Survey of the Emerging 5G Network Edge Cloud Architecture and Orchestration by Tarik Taleb, Konstantinos Samdanis, BadrMada, HannuFlinck, Sunny Dutta and Dario Sabella, IEEE COMMUNICATIONS SURVEYS & TUTORIALS Page 1657 - 1681, VOL. 19, NO. 3, THIRD QUARTER 2017

[8] Combinational Auction-Based Service Provider Selection in Mobile Edge Computing Networks By HELI Zhang1, Fengxian Guo1, Hong Ji1, special section on emerging trends, issues, and challenges in energy-efficient cloud computing page 13455 - 13464, volume 5, 2017

[9] Hybrid Mobile Edge Computing: Unleashing the Full Potential of Edge Computing in Mobile Device Use Cases by Andreas Reiter, Bernd Pr¨unster, Thomas Zefferer, 17th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing Pages 935 – 944, 2017

[10] A Load Balancing Scheme for Sensing and Analytics on a Mobile Edge Computing Network by Chen-KhongTham, Rajarshi Chattopadhyay, IEEE, 2017

[11] Optimal trade-off between accuracy and network cost of distributed learning in Mobile Edge Computing: An analytical approach by Lorenzo Valerio, Andrea Passarella,Marco Conti, IEEE, 2017

[12] Qoe Analysis Of Nfv-Based Mobile Edge Computing Video Application by Suyou Li, Zhigang Guo, GuochuShou, Yihong Hu, Hongxing Li, Proceedings of NIDC, Pages 411 – 415, 2016