

# **MILITARY SURVILLANCE SYSTEM USING IOT AND SENSORS**

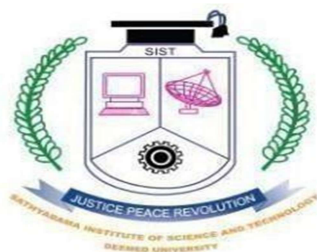
**A Project Report Phase – II**

Submitted in partial fulfillment of the requirements for the award of  
**Bachelor of Degree in Electronics and communication**

**Engineering by**

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION  
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# **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC**

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**APRIL - 2023**



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**BONAFIDE CERTIFICATE**

This is to certify that this Final Year Project Report is the bonafide work of **D.HEAVENA AMIRDAA** ( Reg.No –39130164 ) AND **A.AABARANA SAKTHITHA** ( Reg.No – 39130001 ) who have done the project work as an individual who carried out the project entitled **“MILITARY SURVILLANCE SYSTEM USING IOT AND SENSORS”** under my supervision from Jan 2023 to April 2023.

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## DECLARATION

We, **D.HEAVENA AMIRDAA (Reg.No–39130164)** and **A.AABARANA SAKTHITHA (Reg.No – 39130001)**, hereby declare that the Project Report on “**MILITARY SURVILLANCE SYSTEM USING IOT AND SENSORS**” done by us under the guidance of **Dr.L. MEGALAN LEO** at **Sathyabama Institute of Science and Technology** is submitted in partial fulfilment of the requirements of the award of **Bachelor of Engineering degree in Electronics and Communication Engineering**.

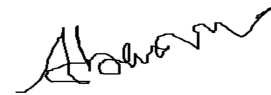
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**SIGNATURE OF CANDIDATE**

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We are pleased to acknowledge our sincere thanks to the Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. N. M. NANDHITHA, M.E., Ph.D. Dean, School of Electrical and Electronics Engineering** and **Dr. T. RAVI, M.E., Ph.D. Head of the Department, Department of Electronics and Communication Engineering** for providing us necessary support and details at the right time during the progressive reviews.

We would like to express my sincere and deep sense of gratitude to our Project Guide **Dr.L. Megalan Leo M.E.Ph.D.**, Assistant professor, **Department of Electronics and Communication Engineering**, for his valuable guidance, suggestions and constant encouragement for the successful completion of our project work.

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## **ABSTRACT**

Military surveillance using IoT(Internet of Things) can get a sensational effect on troopers making the country more secured. Although we have deployed a variety of technology to assist troops during war, these can be also used to reduce their risk of injury and decrease the casualties. Tracking the health and tracing the soldier's location continuously would provide a significant change and help to them in the battle field. This project aims in combining some significant idea and technology which could save and reduce the number of casualties in some basic mission. On the battlefield soldiers are exposed to a variety of traumatic blasts that can cause fatal Traumatic brain damage (TBI), these are left unnoticed till the soldier reaches the base station. The effects of TBI or concussion can decrease individual or unit mission effectiveness, and potentially cause further risk to the safety of the individual or his peers is suspected to occur in soldiers who are exposed to the blast and have a severe concussion later, leading to severe after effects such as vomit, dizziness, blurred vision and tumors which are all fatal. The main objective of the work presented is to design and implement a surveillance system for the soldiers that is composed of a wearable health sensor as a central unit hosted on a Node MCU to read soldier's live location, state, health information and blast sensor to detect the intensity of the blast and which contains a integrated circuit with gyro scope and accelerometer is interfaced with the system along with the other sensor and send notification to the control room to update about the soldier's well-being through IoT-based correspondence framework for troopers. This system is a concept model of an IoT based wearable device for military purposes. This idea can fulfill several use cases in the military. This project aims to bring an effective communication between the soldier and base control by proving the base about the soldier's current health parameters, live location and several other parameters. The microcontroller gets all sensor's values and sends them to the central unit directly using WIFI signals without passing through any access point. Through cloud application the data can be accessed by the control room immediately and by the control room at any time of the mission/post mission. Each soldier must turn on his own device through cloud application the data can be accessed by the control room immediately.

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## LIST OF ABBREVIATIONS

|                |   |                                         |
|----------------|---|-----------------------------------------|
| <b>APDS</b>    | - | Advanced programme in data science      |
| <b>MCP</b>     | - | Microsoft certified professional        |
| <b>LED</b>     | - | Light emitting diode                    |
| <b>GSM</b>     | - | Global system for mobile                |
| <b>GPRS</b>    | - | General packet radio service            |
| <b>SIM</b>     | - | Subscriber identity module              |
| <b>TCP</b>     | - | Transmission control                    |
| <b>IP</b>      | - | Internet protocol                       |
| <b>DCS</b>     | - | Distributed control system              |
| <b>PCS</b>     | - | Power conditioning system               |
| <b>FM</b>      | - | Frequency modulation                    |
| <b>HTTP</b>    | - | Hypertext transfer protocol             |
| <b>SMA</b>     | - | Sub miniature version A                 |
| <b>GPS</b>     | - | Global Positioning System               |
| <b>GLONASS</b> | - | Global Navigation Satellite System      |
| <b>NAVSTAR</b> | - | Navigation System with Time and Ranging |
| <b>NMEA</b>    | - | National Marine Electronics Association |
| <b>VCC</b>     | - | Voltage common collector                |
| <b>TX</b>      | - | Transmitter                             |
| <b>RX</b>      | - | receiver                                |

## CHAPTER 1

### INTRODUCTION

Traumatic brain injury (TBI) is a leading combat casualty. In the wars of the 20th Century, it is estimated that up to 20% of injuries incurred in battle involve the head. For Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF), this is also true. One important distinction of OEF and OIF is the high incidence of TBI from explosive blast injury. TBI has been referred to as the 'signature injury' of these conflicts. Exposure to explosive blast has occurred since gunpowder was first introduced to the battlefield. The reason that it is now being recognized as an important contributor to war-related TBI is varied and uncertain. Certainly, improvised explosive devices (IEDs) are preferred weapons of our adversaries. As a result, a disproportionate number of injuries are caused by IEDs. Another reason is that protective body armor worn by modern war fighters effectively mitigates many traditional combat injuries such as thoracic and abdominal penetrating injuries. However, modern combat helmets have not significantly added more protective surface area than latter 20th- Century helmets. Thus, as soldiers are surviving greater blast exposures than in previous conflicts, the contribution of TBI has thus proportionally increased. Another reason may be increased awareness. In the past, some patients suffering from mild TBI may have been inappropriately diagnosed with post- traumatic stress disorder (PTSD), which is also a common war casualty. Through the efforts of the Defense and Veterans Brain Injury Centre (DVBIC), almost every military healthcare provider is being trained in diagnosis and clinical care of TBI. Critically, efforts are made to distinguish TBI from PTSD. Other potential contributors have been suggested such as chemical composition of explosive, helmet materials, and so on.

## 1.1 PROBLEM STATEMENT

The main aim of the system is to reduce the risk of TBI in soldiers by early detection. The blasts that occur in the battlefield is not measured and the impact on the soldiers are left unnoticed. There is also no proper immediate communication between the soldier and the base control about the soldier's wellbeing, due to which they have higher risk of fatal internal injuries which are left undiagnosed. The effects of TBI or concussion can decrease individual or unit mission effectiveness, and potentially cause further risk to the safety of the individual or his peers. While TBI might be suspected after any injury that causes a significant blow to the head, there is also risk for brain injury related to the Through constant monitoring and immediate communication to the base station about the soldier's exposure level in the blast will help in reduction of all these fatal risks, there by assisting the soldier to provide a more efficient performance in their next mission.

## 1.2 OBJECTIVE

To enable real time vitals monitoring along with video of soldiers while in battlefield using HBC-HMI node communication. It is used to enable live tracking of the soldiers in the battlefield. To detect the intensity of the blast in the field using blast sensors and send notification to the control room through IoT platform. It helps to enable immediate communication and sharing of live status of the soldier's wellbeing without delay. It is used to help the soldiers to reduce the risk of TBI by early detection through the measurement of the vibration's intensity.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 WEARABLE HEALTH MONITORING USING CAPACITIVE VOLTAGE-MODE HUMAN BODY COMMUNICATION.

***Maity, S., Das, D. and Sen, S., 2017, July. In 2017 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)(pp. 1-4). IEEE.***

Rapid miniaturization and cost reduction of computing, along with the availability of wearable and implantable physiological sensors have led to the growth of human Body Area Network (BAN) formed by a network of such sensors and computing devices. One promising application of such a network is wearable health monitoring where the collected data from the sensors would be transmitted and analysed to assess the health of a person. Typically, the devices in a BAN are connected through wireless (WBAN), which suffers from energy inefficiency due to the high-energy consumption of wireless transmission. Human Body Communication (HBC) uses the relatively low loss human body as the communication medium to connect these devices, promising order(s) of magnitude better energy-efficiency and built-in security compared to WBAN. In this paper, we demonstrate a health monitoring device and system built using Commercial-Off-The-Shelf (COTS) sensors and components, that can collect data from physiological sensors and transmit it through a) intra-body HBC to another device (hub) worn on the body or b) upload health data through HBC-based human-machine interaction to an HBC capable machine. The system design constraints and signal transfer characteristics for the implemented HBC-based wearable health monitoring system are measured and analysed.

#### 2.2 SELECTION AND EVOLUTION OF MEMS ACCELEROMETER SENSOR FOR MEASUREMENT OF BLAST-INDUCED PEAK PARTICLE VELOCITY.

***Ragam .P and Nimaje .D .S, in IEEE Sensors Letters, vol. 2, no. 4, pp.1-4, Dec.2018.***

An ambiguous ground vibration caused by blasting operation is undesirable and results in grievous damage to surrounding structures, residential premises, and other sensitive sites. Consequently, proper monitoring of ambiguous ground vibration is an indispensable prerequisite to pinpoint the safe limits in and around mines to reduce their hazardous effects. The recently proliferated micro electron mechanical-system (MEMS) based accelerometer sensors are becoming widely prevalent in vibration and condition monitoring applications. In this article, a three-axis, low-g, high-accuracy, inexpensive MEMS accelerometer has been selected and evaluated to measure blast-induced ground vibration. In addition, a global system for a mobile SIM800 device is used as a radio frequency module and integrated to design an effective test setup. The experiment has been carried out by installing test setup at Mine-A, and the obtained results ensure that the peak particle velocity ranges from 0.19 to 8.60 mm/s at different monitoring locations. Blasting is an economical and viable operation for reliable excavation of hard rock in mining and civil construction. A part of the energy (20%–30%) used in blasting the explosive produces fragmentation of rocks, and the remaining energy (70%–80%) is lost in the form of fly-rock debris, air noise, and ground vibration. Multiple researchers and academicians have utilized different conventional monitoring systems to measure blast-induced ground vibration data in terms of peak particle velocity (PPV) in opencast mines. Yan *et al.* used the Instantel-Minimate Pro4 device to measure the ground vibration at Shanghongyan village, China.

Ragam and Nimaje installed an Instantel-Minimate Plus instrument at different mines in India to monitor the vibration intensity level. Monjezi *et al.* employed the MR 2002-CE system to record the ground vibration in and around the Shur River Dam, Iran, at different vulnerable and strategic locations.

Faradonbeh *et al.* employed a Vibra ZEB VM instrument to detect the vibration wave amplitude at a granite quarry in Malaysia. depicts a typical conventional system (Instantel-Minimate Plus) along with its accessories. It consists of two or more sensors, namely, three axis-geophone and microphone. The primary intends of the geophone and microphone are to measure the ground vibration and the air blast, respectively. Usually, mine experts consider PPV (mm/s) as a representation of the blast-induced ground vibration.

### 2.3 MILITARY UNIFORM FOR HEALTH ANALYTICS FOR FIELD INTELLIGENT ZONE(MUHAFIZ) PROTECTING THE ONES THAT PROTECT OUR LAND.

***Muhammad Arsalan, Asghar Ashraf Musani, Syed Asad Ailia, Nabeel Baig; Engr.M.Kashif Shaikh. .2018 2nd International Conference on Smart Sensors and Application(ICSSA).***

Armed forces are one of the most integral part of any country. Being in one of the most hostile and critical environment they constantly face both mental and physical challenges. Those soldiers are always at risk and when met with an unfortunate incident, they remain isolated from instantaneous medical help. In these situations, it is essential to monitor and track each individual in real-time so that it can be concluded from the accumulated data as which individual requires immediate medical help and which one performs exceptionally well that can be considered a preferred candidate for the up-coming specific missions.

In this paper, we present the system of an embedded next generation tactical suit designed for monitoring health statistics/analytics of an armed personnel. The suit has an onboard integrated CPU that extracts data from multiple sensors and send this information using LoRaWAN (Long Range Wide Area Network) technology. This information is recorded into the database, according to each suit and can be viewed in real-time or with respect to each individual. The paper also discusses the advantages of using LoRa and describes the system architecture and the working of the suit.

### 2.4 PRASHANTH R, NIMAJE D. ESTIMATION OF AMBIGUOUS BLAST-INDUCED GROUND VIBRATION USING INTELLIGENT MODELS: A CASE STUDY.NOISE & VIBRATION WORLDWIDE.2018.

Blasting is an economical and viable operation for reliable excavation of hard rock in mining and civil construction. An ambiguous ground vibration generated by blasting is unenviable and causes grievous damage to nearby inhabitants, residential premises, and other sensitive sites. Accordingly, the proper assessment of indistinct blast induced ground vibration is a requisite to pinpoint the safe limits in and around mines. An endeavor has been made in this article to apply four predictive models, namely, support vector machine, feed forward back propagation neural network, cascaded forward back propagation neural network, and radial basis function neural network to

estimate the ground vibration caused by blasting operation conducted at Mine-A, India. In this article, a total number of 121 blasting operations with relevant parameters are recorded. The most influential parameters of ground vibration are the number of holes, burden, spacing, hole diameter, hole depth, top stemming, maximum explosive charge per delay, and the distance from blast source, which we reconsidered as input parameters. Ground vibration is measured in terms of peak particle velocity and is considered as output.

The performance indicators of constructed network models were chosen as the coefficient of determination ( $R^2$ ), root mean square error, and variance account for. Among all constructed intelligent models, the radial basis function neural network with architecture 8-80-1 and  $R^2$  of 0.9918, root mean square error of 4.4076, and variance account for of 99.1800 was found to be optimum. Sensitivity analysis showed that the number of holes, burden, and top stemming are the most effective parameters leads to ground vibration due to blasting.

## 2.5 A 100KHZ-1GHZ TERMINATION DEPENDENT HUMAN BODY COMMUNICATION CHANNEL MEASUREMENT USING MINIATURIZED WEARABLE DEVICES

***S.Avlani, M. Nath, S. Maity and S. Sen, 2020 Design, Automation & Test in Europe Conference & Exhibition (DATE), 2020.***

Human Body Communication has shown great promise to replace wireless communication for information exchange between wearable devices of a body area network. However, there are very few studies in literature, that systematically study the channel loss of capacitive HBC for wearable devices over a wide frequency range with different terminations at the receiver, partly due to the need for miniaturized wearable devices for an accurate study. This paper, for the first time, measures the channel loss of capacitive HBC from 100KHz to 1GHz for both high- impedance and  $50\Omega$  terminations using wearable, battery powered devices; which is mandatory for accurate measurement of the HBC channel-loss, due to ground coupling effects. Results show that high impedance termination leads to a significantly lower channel loss (40 dB improvement at 1MHz), as compared to  $50\Omega$  termination at low frequencies.

This difference steadily decreases with increasing frequency, until they become similar near 80MHz. Beyond 100MHz inter-device coupling dominates, thereby preventing accurate measurements of channel loss of the human body.

The measured results provide a consistent wearable, wide- frequency HBC channel loss data and could serve as a backbone for the emerging field of HBC by aiding in the selection of an appropriate operation frequency and termination. the army base stations. In today's world the security of the nation is depends up on the enemies with warfare and so the safety of the soldier is considered as vital role in it. Concerning the soldier's safety there are many instruments to view their health status as well as ammunitions on the soldier. past, some patients suffering from mild TBI may have been inappropriately diagnosed with post-traumatic stress disorder (PTSD), which is also a common war casualty. Through the efforts of the Defence and Veterans Brain Injury Centre (DVBIC), almost every military healthcare provider is being trained in diagnosis and clinical care of TBI. Critically, efforts are made to distinguish TBI from PTSD. Other potential contributors have been suggested such as chemical composition of explosive, helmet materials, and so on.

## CHAPTER 3

### METHODOLOGY

#### 3.1 EXISTING METHODOLOGY

The last decade witnessed remote human health monitoring by virtue of monitoring its physiological signs using transmission over telephone line. Though these systems provided real-time operation, it suffered from drawback such as limited bandwidth, signal degradation and high operational cost. Microcontroller based soldier health tracking and indication system used Google Map for the location mapping of the soldiers. Lim et al reported an on-going effort to develop a system consisting of interconnected body sensor networks (BSNs) for real time health monitoring of soldiers. They suggested the use of various wearable, portable, light weight sensors to monitor human physiological parameters. ARM processor-based mechanism was proposed for the safety of soldiers. The ARM processor is supported with various sensors and GPS module to track the position of a soldier on the battlefield. A mobile health monitoring system employed a BSN comprises of a microcontroller and RF transceiver from Texas instrument. An IoT based approach was reported it used Raspberry Pi board to collect the human vital signs which further added to the cloud-based website. It is evidenced from the reported methodologies that very few efforts are initiated in the direction of soldier's health, detection of the intensity of the blast and location tracking on the battlefield. Further, the reported system suffers from one or more limitations like implementation on cost, slow response and bulky nature.

These drawbacks can be overcome by using a portable wireless real-time system. The proposed system will also provide the real-time data of soldier's health and exposure of the vibration intensity on the body, exact geographical position to control room and provide immediate notification to the control room in case of any abnormality in exposure range during the incident of blast using internet of things (IoT). This feature will help to overcome the problem of "soldier missing in action" and "reduce the risk of undiagnosed TBI". Some of the drawbacks of the existing system are

- No effort taken to detect the blast exposure range on soldier.
- No means to alert to base control.

### 3.2 PROPOSED METHODOLOGY

The proposed system focuses in combining all the valuable features into a single wearable device which can provide an efficient performance in minimizing the risk and threat in health of our soldiers. Collection of various vitals of the soldier is continuous and ensures fitness through HBC-HMI then send the data via NodeMcu to the cloud using Wi-Fi. Blast sensor – that contains a vibration sensor interfaced with the system along with the other sensor. Detects the intensity of the blast in the field using blast sensors measured through vibration level and sends notification to the control room. Through the collected data the troop leader can decide which soldier will require an immediate attention to avoid any fatal brain injuries from which the soldier can never recover easily. Enable live tracking of the soldiers in the battlefield. All of the recorded parameters come from different sensors are interfaced with the HBC\_HMI and is sent to the base reception together with no delay in between. Through the built in wi-fi in the processor the node-to-node communication between the sensors in the wearable suit can communicate at ease. Through cloud application, the data can be accessed by the control room immediately.

Some of the advantages of the existing system:

- level of exposure range due to blast is measured.
- Immediate alert sent to base through sms.
- No delay in communication between nodes.
- Fast response.
- Low cost of operation.

### 3.3 DIFFERENCE BETWEEN EXISTING METHODOLOGY AND PROPOSED METHODOLOGY

#### **3.3.1 Existing methodology**

1. All of the recorded parameters come from different sensors and is sent to the base reception individually with some delay in between.
2. The existing systems can detect the bomb but cannot measure its intensity immediately.

#### **3.3.2 Proposed methodology**

1. All the recorded parameters come from different sensors are interfaced with the HBC\_HMI and is sent to the base reception together with no delay in between them.

2. Detects the intensity of the blast in the field using blast sensors measured through vibration level and sends notification to the control room.

### 3.4 HARDWARE COMPONENTS

- ☐ Arduino UNO
- ☐ NODEMCU
- ☐ Pulse Sensor
- ☐ Power Supply
- ☐ GSM
- ☐ GPS
- ☐ Vibration Sensor

#### **3.4.1 Arduino uno**

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load newcode onto the board you can simply use a USB cable.

Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners.

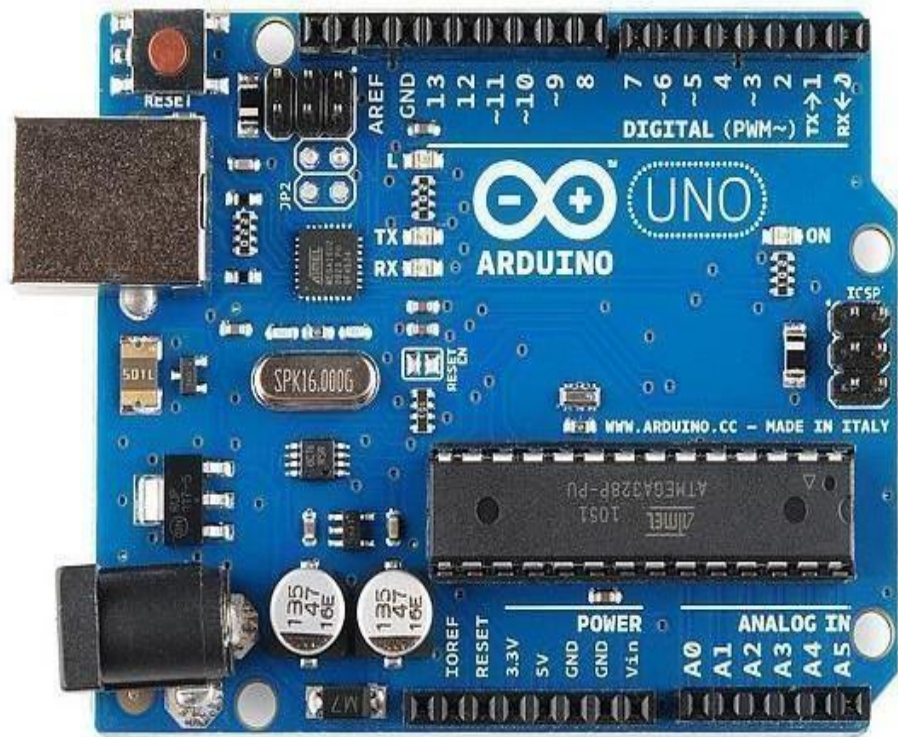


Fig 3.1 Arduino

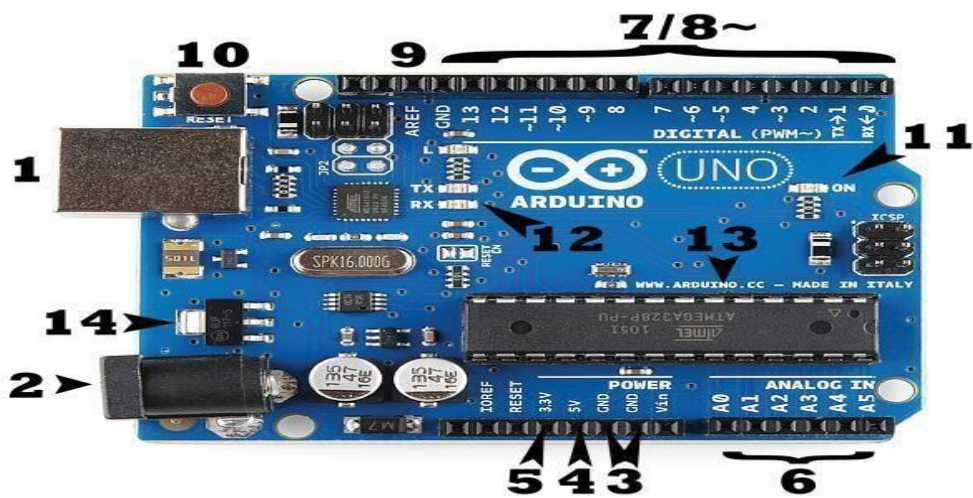


Fig 3.2 Arduino Pinout

(a) *Power (USB / Barrel Jack)*

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply (like this) that is terminated in a barrel jack. In the picture above the USB connection is labelled **(1)** and the barrel jack is labelled **(2)**.

The USB connection is also how you will load code onto your Arduino board. More on how to program with Arduino can be found in our Installing and Programming Arduino tutorial.

**NOTE:** Do NOT use a power supply greater than 20 Volts as you will overpower (and thereby destroy) your Arduino.

The recommended voltage for most Arduino models is between 6 and 12 Volts.

**Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF)**

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire).

They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labelled on the board and used for different functions.

**GND (3):** Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.

**5V (4) & 3.3V (5):** As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.

**Analog (6):** The area of pins under the 'Analog In' label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.

**Digital (7):** Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).

**PWM (8):** You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse -Width Modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

**AREF (9):** Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

*(b) Reset Button*

Just like the original Nintendo, the Arduino has a reset button **(10)**. Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino.

This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

*(c) Power LED Indicator*

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' **(11)**. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

*(d) TX RX LEDs*

TX is short for transmit RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs **(12)**.

These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program onto the board).

*(e) Main IC*

The black thing with all the metal legs is an IC, or Integrated Circuit **(13)**. Think of it as the brains of our Arduino.

The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC's from the ATMEL company.

This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software.

This information can usually be found in writing on the top side of the IC. If you want to know more about the difference between various IC's, reading the datasheets is often a good idea.

(f) *Voltage Regulator*

The voltage regulator **(14)** is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says — it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

(g) *ATMEGA328 Microcontroller*

The Atmel AVR® core combines a rich instruction set with 32 general purpose working registers.

All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle.

The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega328/P provides the following features:

32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs, 1 byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes.

The Boot program can use any interface to download the application program in the Application Flash memory.

Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation.

By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost-effective solution to many embedded control applications.



Fig 3.3 Arduino Pinout

Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output- activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers -students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Arduino — Arduino Board Uno Each of the 14 digital pins on the Uno can

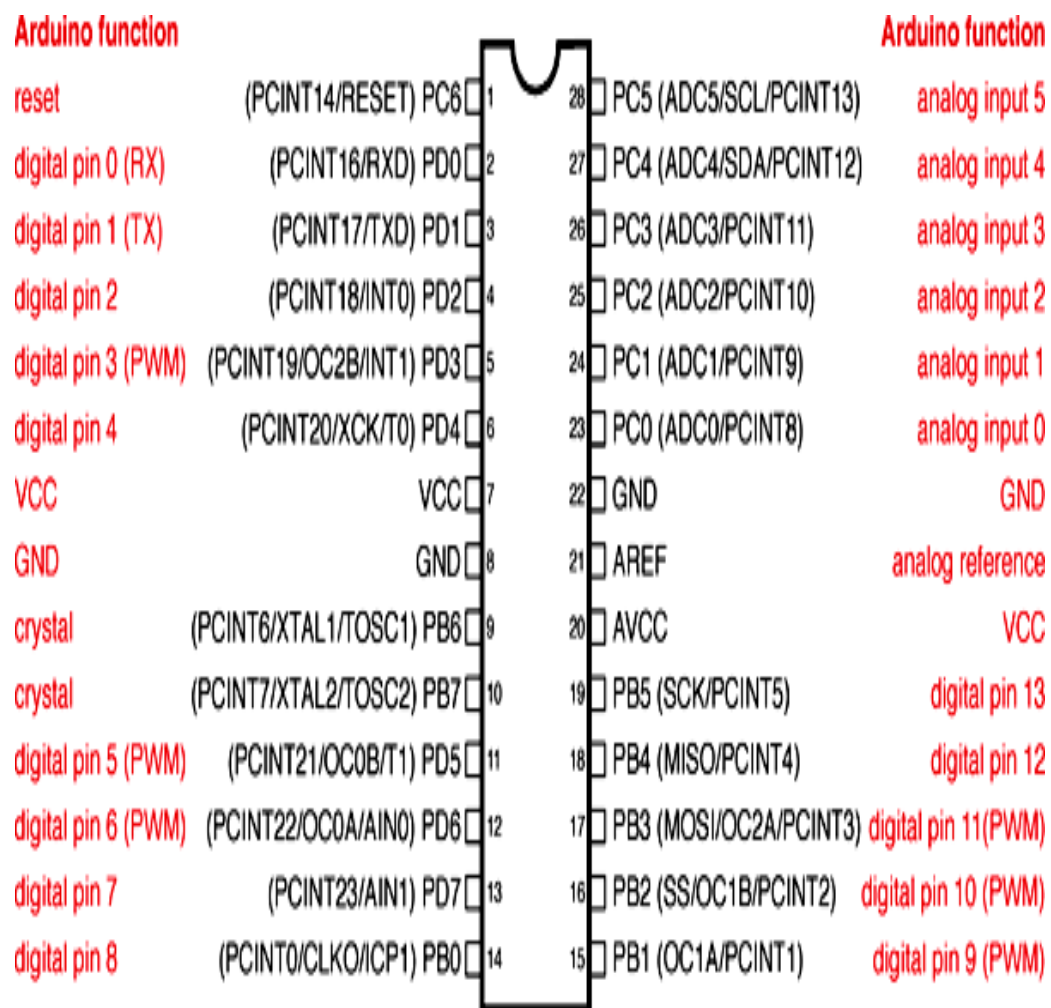
be used as an input or output, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

|                           |                                               |
|---------------------------|-----------------------------------------------|
| Microcontroller           | ATmega328P – 8 bit AVR family microcontroller |
| Operating Voltage         | 5V                                            |
| Recommended Input Voltage | 7-12V                                         |
| Input Voltage Limits      | 6-20V                                         |
| Analog Input Pins         | 6 (A0 – A5)                                   |
| Digital I/O Pins          | 14 (Out of which 6 provide PWMoutput)         |
| DC Current on I/O Pins    | 40 mA                                         |
| DC Current on 3.3V Pin    | 50 mA                                         |
| Flash Memory              | 32 KB (0.5 KB is used for Bootloader)         |
| SRAM                      | 2 KB                                          |
| EEPROM                    | 1 KB                                          |

The Arduino Uno 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 of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, 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 includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-t serial chip and USBconnection to the computer (but not for serial communication on pins 0 and 1).



Digital Pins 11, 12 & 13 are used by the ICSP header for MOSI, MISO, SCK connections (Atmega168 pins 17, 18 & 19). Avoid low-impedance loads on these pins when using the ICSP header.

Fig 3.4 Pin layout of Arduino

### 3.4.2 *Nodemcu introduction*

- When prototyping new IoT equipment, development boards such as Arduino and Raspberry Pi are popular options.
- These development boards are fundamentally mini-computers that a normal PC or Mac can connect to and program.
- The design boards can then connect and regulate sensors in the field after it has been programmed. The design boards need a way to connect to the internet because the "I" in IoT stands for internet.
- In the field, using wireless networks is the best way to connect to the Internet. However, wireless networks are not supported by Arduino and Raspberry Pi. In order to access the wireless module, developers will need to add a wifi or cellular module to the board and write code.
- I will present an open source IoT development board called Nodemcu in this paper. One of its most distinctive characteristics is that it has built- in wifi connectivity assistance, making the development of IoT applications much easier.



Fig 3.5 The NodeMCU DEVKIT board

- The Nodemcu (Node Micro Controller Unit) is an open source software and hardware development environment around the ESP8266, a very inexpensive system-on - a-chip (SoC) environment.
- The ESP8266, designed and manufactured by Express if Systems, involves all the main parts of modern pcs: CPU, RAM, networking (Wifi), and even a modern operating system and SDK. When purchased in bulk, the ESP8266 chip costs just \$2 USD a piece. This makes it a excellent choice for IoT initiatives of all kinds.
- The ESP8266, however, is also difficult to access and use as a chip. For the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip, you have to solder wires with the appropriate analog voltage.
- And, you have to program it in instructions for low-level machines thatthe chip hardware can interpret. While this level of integration is not an issue when the ESP8266 is used in mass-produced electronics asan integrated controller chip,
- it is a enormous burden on hobbyists, hackers, or learners who want to experiment with it in their own IoT projects.
- Borrowing a page from the successful playbooks of Arduino or a Raspberry Pi, the NodeMCU project aims to simplify ESP826 development. It has two key components.
- An open source firmware ESP8266 constructed on top of the proprietary SDK of the chip manufacturer.
- The firmware offers a easy programming environment based on eLua (integrated Lua), which with an established developer community is a very easy and quick scripting language.
- The panel has an integrated USB port with the chip, a hardware resetbutton, a wifi antenna, LED lights, and standard GPIO (General Purpose Input Output) pins that can be plugged into a breadboard. The DEVKIT board is shown in Figure 1 and its buttons are shown in Figure 3. 6

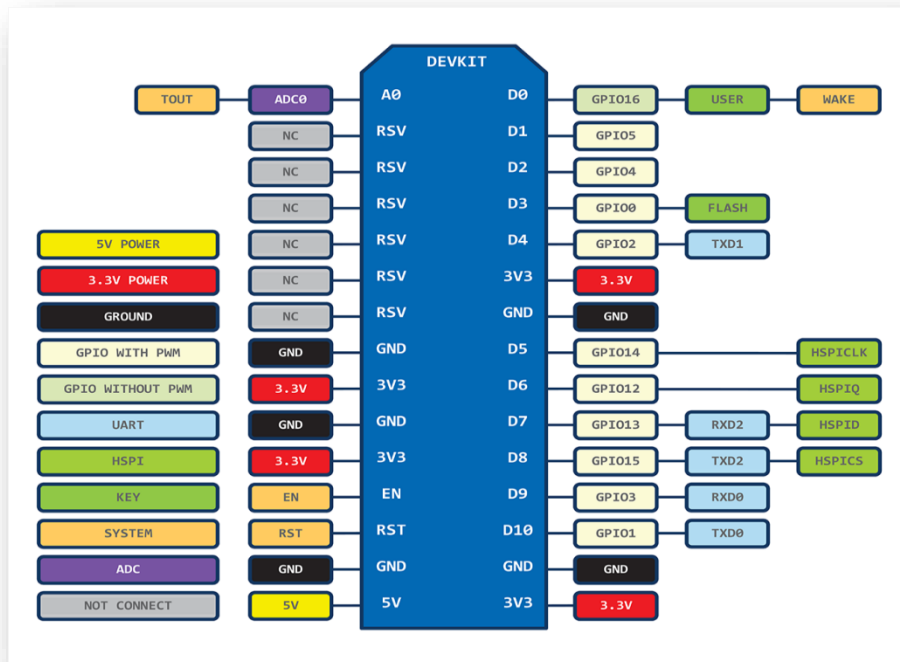


Fig 3.6 The NodeMCU pin schema

□ For a flexible IoT controller, the Arduino project produces an open source hardware architecture and SDK software.

(a) The Arduino hardware, similar to Nodemcu, is a microcontroller board with a ready-to-use USB connector, LED lights, and normal information pins. It also describes normal interfaces for sensors or other boards to communicate with. But unlike Nodemcu, with memory chips and a range of programming settings, the Arduino board can have distinct kinds of CPU chips.

(b) *Need of internet of things:*

□ Some future consumer applications envisioned for IoT sound like science fiction, but some of the more practical and realistic sounding possibilities for the technology include:

□ Receiving warnings on your phone or wearable device when IoT networks detect some physical danger is detected nearby (think: smart smoke detectors).

□ Self-parking automobiles (think: Volvo S90).

□ Automatic ordering of groceries and other home supplies (think:

AmazonDash Wand).

- ☐ Automatic tracking of exercise habits and other day-to-day personal activity including goal tracking and regular progress reports (think: fitness trackers).

(c) *Potential benefits of IoT in the business world include:*

- ☐ Location tracking for individual pieces of manufacturing inventory.
- ☐ Fuel savings from intelligent environmental modelling of gas-powered engines.
- ☐ New and improved safety controls for people working in hazardous environments.

(d) *Network Devices and the Internet of Things*

- ☐ All kinds of ordinary household gadgets can be modified to work in an IoT system. WiFi network adapters, motion sensors, cameras, microphones and other instrumentation can be embedded in these devices to enable them for work in the Internet of Things.
- ☐ Home automation systems already implement primitive versions of this concept for things like smart light bulbs, plus other devices like wireless scales and wireless blood pressure monitors that each represents early examples of IoT gadgets.
- ☐ Wearable computing devices like smart watches and glasses are also envisioned to be key components in future IoT systems.
- ☐ The same wireless communication protocols like Wi-Fi and Bluetooth naturally extend to the Internet of Things also.

(e) *Issues Around IoT:*

- ☐ Internet of Things immediately triggers questions around the privacy of personal data. Whether real-time information about our physical location or updates about our weight and blood pressure that may be accessible by our health care providers, having new kinds and more detailed data about ourselves streaming over wireless networks and potentially around the world is an obvious concern.
- ☐ Supplying power to this new proliferation of IoT devices and their network connections can be expensive and logistically difficult. Portable devices require batteries that someday must be replaced.
- ☐ Although many mobile devices are optimized for lower power usage, energy

costs to keep potentially billions of them running remains high.

- Numerous corporations and start-up ventures have latched onto the Internet of Things concept looking to take advantage of whatever business opportunities are available.
- While competition in the market helps lower prices of consumer products, in the worst case it also leads to confusing and inflated claims about what the products do.
- IoT assumes that the underlying network equipment and Related technology can operate semi-intelligently and often automatically.
- Simply keeping mobile devices connected to the Internet can be difficult enough much less trying to make them smarter.
- People have diverse needs that require an IoT system to adapt or be configurable for many different situations and preferences.
- Finally, even with all those challenges overcome, if people become too reliant on this automation and the technology is not highly robust, any technical glitches in the system can cause serious physical and/or financial damage.

(f) *Cloud computing*

- Whenever you travel through a bus or train, you take a ticket for your destination and hold back to your seat till you reach your destination.
- Likewise, other passengers also take ticket and travel in the same bus with you and it hardly bothers you where they go. When your stop comes you get off the bus thanking the driver.
- Cloud computing is just like that bus, carrying data and information for different users and allows to use its service with minimal cost.
- Cloud Computing can be defined as delivering computing power (CPU, RAM, Network Speeds, Storage OS software) a service over a network (usually on the internet) rather than physically having the computing resources at the customer location.
- **Example:** AWS, Azure, Google Cloud
- *Benefits of Cloud Computing*
- The potential for cost saving is the major reason of cloud services adoption by many organizations.
- Cloud computing gives the freedom to use services as per the requirement and pay only for what you use. Due to cloud computing it has become

possible to run IT operations as a outsourced unit without much in-house resources.

Following are the benefits of cloud computing:

- ☐ Lower IT infrastructure and computer costs for users
- ☐ Improved performance
- ☐ Fewer Maintenance issues
- ☐ Instant software updates
- ☐ Improved compatibility between Operating systems
- ☐ Backup and recovery
- ☐ Performance and Scalability
- ☐ Increased storage capacity
- ☐ Increase data safety

### **3.4.3 Pulse Sensor**



fig 3.7 Pulse sensor

The Pulse Sensor is a well-designed low-power plug-and-play heart- rate sensor for the Arduino. It can be used by students, artists, athletes, manufacturers, and game & mobile developers who want to incorporate live heart-rate data into their projects.

And the best part is that this sensor plugs right into Arduino and easily clips onto a fingertip or earlobe. It is also super small (button-shaped) with holes, so it can be sewn into fabric.

The front of the sensor is the side with the heart logo. This is where you place your finger. On the front side you will see a small round hole, from where the King Bright's reverse mounted green LED shines.

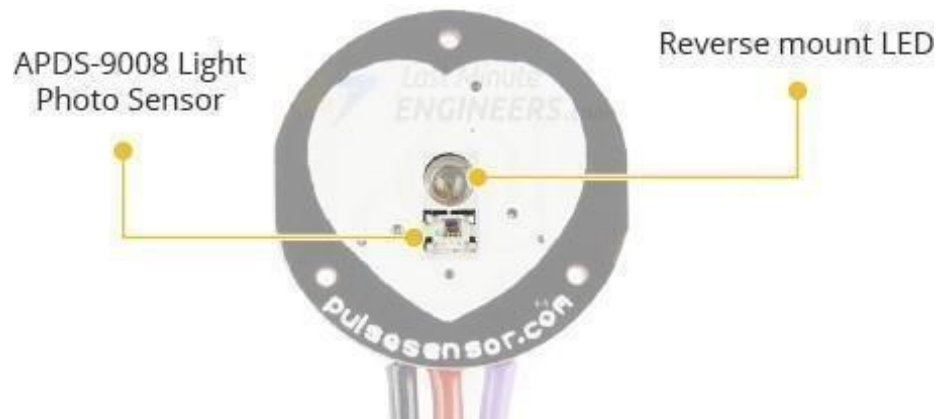


Fig 3.8 Outer layer of the pulse sensor

Just below the LED is a small ambient light photo sensor — APDS-9008 from Avago, similar to that used in cell phones, tablets and laptops, to adjust the screen brightness in different light conditions.

On the back of the module you will find the rest of the components including a microchip's MCP6001 Op-Amp and a bunch of resistors and capacitors that make up the R/C filter network. There is also a reverse protection diode to prevent damage if the power leads are accidentally reversed.

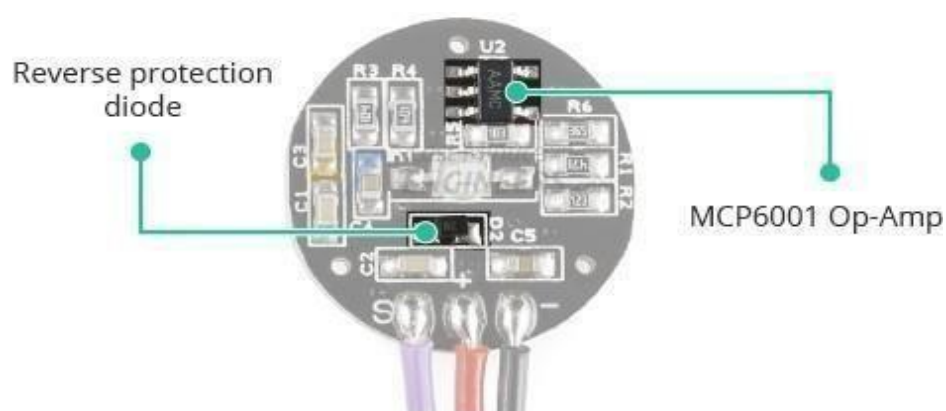


Fig 3.9 Inner layer of the pulse sensor

(a) *Working of the pulse sensor*

Optical heart-rate sensors are very easy to understand in theory. If you've ever shined a flashlight through your finger tips and seen your heartbeat pulse, you have a good handle on the theory of optical heart-rate pulse sensors.

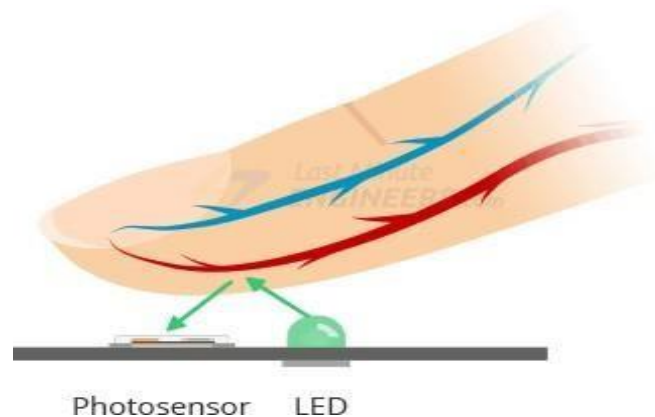


Fig 3.10 Representation of the interaction between finger and the sensor

A pulse sensor or any optical heart-rate sensor, for that matter, works by shining a green light ( $\sim 550\text{nm}$ ) on the finger and measuring the amount of reflected light using a photo sensor. This method of pulse detection through light is called Photo plethysmogram.

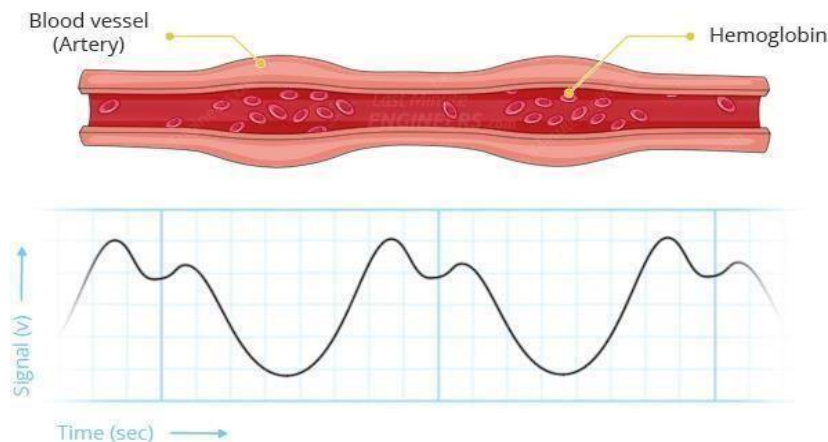


Fig 3.11 Photo plethysmogram

The oxygenated hemoglobin in the arterial blood has the characteristic of absorbing green light. The redder the blood (the higher the hemoglobin), the greener light is absorbed. As the blood is pumped through the finger with each heartbeat, the amount of reflected light changes, creating a changing waveform at the output of the photo sensor. As you continue to shine light and take photo sensor readings, you quickly start to get a heart-beat pulse reading.

This signal from the photo sensor is generally small and noisy, therefore the signal is passed through an R/C filter network and then amplified using an Op Amp to create a signal that is much larger, cleaner and easier to detect.

#### Pulse Sensor Pinout

The sensor comes with a 24" flat ribbon cable with 3 male headerconnectors. The following diagram shows the pinout.



Fig 3.12 Pulse sensor pins

**S (Signal)** is the signal output. Connects to analog input of an Arduino.

**+ (VCC)** is the VCC pin. Connects to 3.3 or 5V.

**– (GND)** is the Ground pin.

(b) *Wiring Pulse Sensor with Arduino:*

Hooking up the Pulse Sensor to an Arduino is super simple. You only need to connect three wires: two for power and one for reading the sensor value.

The module can be powered from 3.3 or 5V. The positive voltage connects to '+' and ground connects to '-'. The 3rd 'S' wire is the analog signal output from the sensor and this will connect to the A0 analog input of an Arduino.

In order to run the subsequent sketches you'll need to install a library called 'Pulse Sensor Playground'.

To install the library, navigate to the **Sketch > Include Library > Manage Libraries...** Wait for Library Manager to download libraries index and update list of installed libraries.

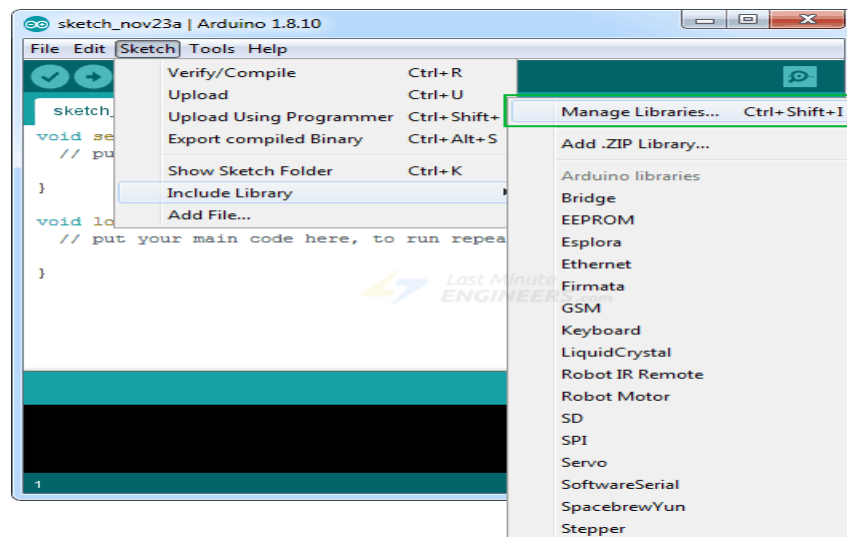


Fig 3.13 Screen shot of library installation-1

Filter your search by typing '**pulse sensor**'. There should be only one entry. Click on that, and then select Install.

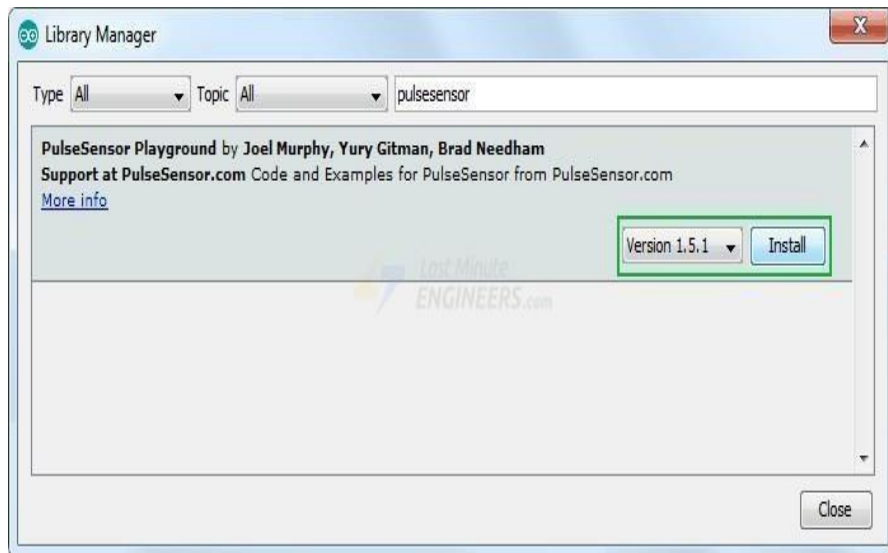


Fig 3.14 Screen shot of library installation-2

(c) *Pulse Sensor Example Sketches*

The Pulse Sensor library has a number of example sketches. We'll go over a few of them here but you can also try the other ones. You can use these example sketches as a basis for developing your own code.

To access the example sketches, navigate to the **File > Examples > Pulse Sensor Playground**. You will see a selection of example sketches. Select any of them to load the sketch into your IDE. Let's begin with the **Getting Started Project**.

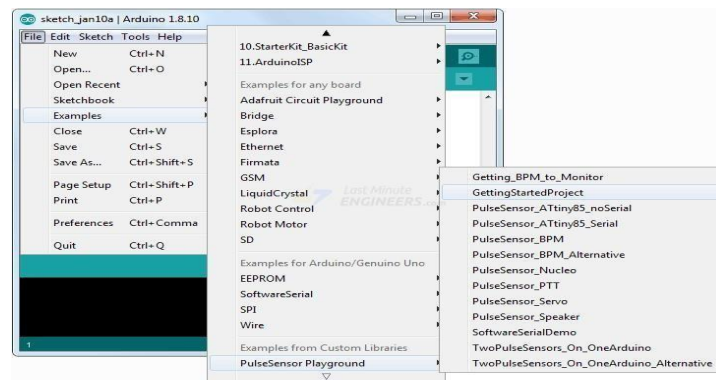


fig 3.15 Pulse Sensor Example

### 3.4.4 power supply circuit

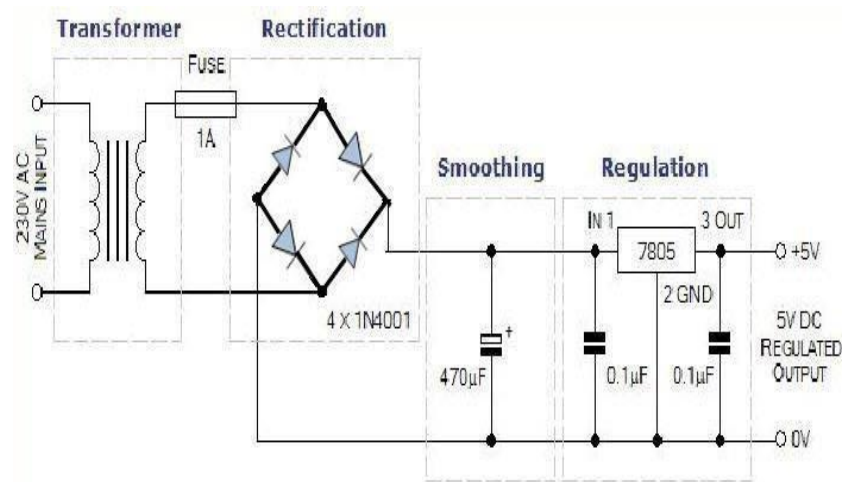


Fig 3.16 Power supply circuit

A bridge rectifier circuit is a common part of the electronic power supplies. Many electronic circuits require rectified DC power supply for powering the various electronic basic components from available AC mains supply. We can find Bridge Rectifier Operation.

As we discussed above, a single-phase bridge rectifier consists of four diodes and this configuration is connected across the load. For understanding the bridge rectifier's working principle, we have to consider the below circuit for demonstration purpose.

During the Positive half cycle of the input AC waveform diodes D1 and D2 are forward biased and D3 and D4 are reverse biased. When the voltage, more than the threshold level of the diodes D1 and D2, starts conducting – the load current starts flowing through it, as shown as red lines path in the diagram below.

During the negative half cycle of the input AC waveform, the diodes D3 and D4 are forward biased, and D1 and D2 are reverse biased. Load current starts flowing through the D3 and D4 diodes when these diodes start conducting as shown in the figure. We can observe that in both the cases, the load current direction is same, i.e., up to down as shown in the figure — so unidirectional, which means DC current. Thus, by the usage of a bridge rectifier, the input AC current is converted into a DC current. The output at the load with this bridge wave rectifier

is pulsating in nature, but for producing a pure DC requires additional filter like capacitor. The same operation is applicable for different bridge rectifiers, but in case of controlled rectifiers thyristors triggering is necessary to drive the current to load.

(a) *Voltage regulator*

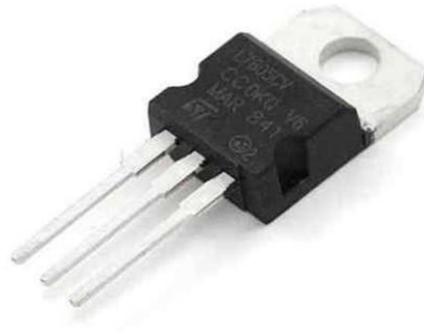


Fig 3.17 Voltage regulator

The name says it all: voltage regulator. The battery in your car that gets charged from the alternator, the outlet in your home that provides all the electricity you desire, the cell phone you likely keep on-hand every minute of the day they all require a specific voltage in order to function. Fluctuating outputs that jump from  $\pm 2V$  can cause inefficient operation and possibly even damage to your charging devices. There's a variety of reasons why a voltage fluctuation may occur: condition of the power grid, other appliances turning off and on, time of day, environmental factors, etc. Due to the need for a steady, constant voltage, enter the voltage regulator.

A voltage regulator is an integrated circuit (IC) that provides a constant fixed output voltage regardless of a change in the load or input voltage. It can do this many ways depending on the topology of the circuit within, but for the purpose of keeping this project basic, we will mainly focus on the linear regulator. A linear voltage regulator works by automatically adjusting the resistance via a feedback loop, accounting for changes in both load and input, all while keeping the output voltage constant.

(b) *Filter*

In power supplies, capacitors are used to smooth (filter) the pulsating DC output after rectification so that a nearly constant DC voltage is supplied to the

load. The pulsating output of the rectifiers has an average DC value and an AC portion that is called ripple voltage. Filter capacitors reduce the amount of ripple voltage to a level that is acceptable. It should be noted that resistors and inductors can be combined with the capacitors to form filter networks. Here we will concentrate on capacitive filters only. In a filter circuit the capacitor is charged to the peak of the rectified input voltage during the positive portion of the input. When the input goes negative, the capacitor begins to discharge into the load. The rate of discharge is determined by the RC time constant formed by the capacitor and the load's resistance. Filters is used to removes ripples and noise.

### **3.4.5 GSM**

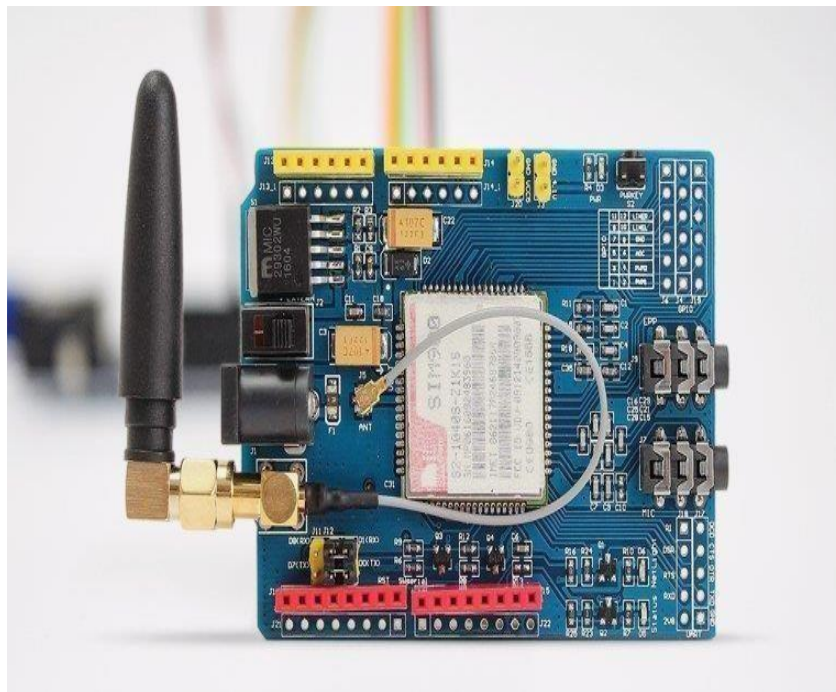


Fig 3.18 GSM

Whether you want to listen to what happens in your house that's milesaway from you or activate sprinkler system in your garden just with a silent call; Then SIM900 GSM/GPRS shield serves as a solid launching point for you to get you started with IoT SIM900 GSM/GPRS shield is a GSM modem, which can be integrated into a great number of IoT projects. You can use this shield to accomplish almost anything a normal cell phone can; MS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the shield supports quad- band GSM/GPRS network, meaning it works pretty much anywhere in the world.

The SIM900 GSM/GPRS shield is designed to surround the SIM900 chip with everything necessary to interface with Arduino, plus a few extra goodies to take advantage of the chip's unique features.

Let's familiarize ourselves with these features and abilities of the shield. Here's a quick overview:

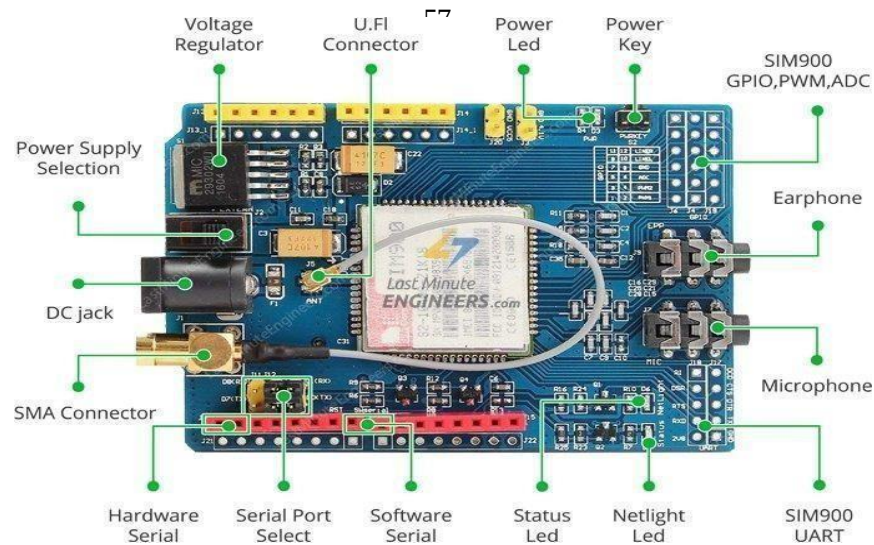


Fig 3.19 Features of GSM (front)

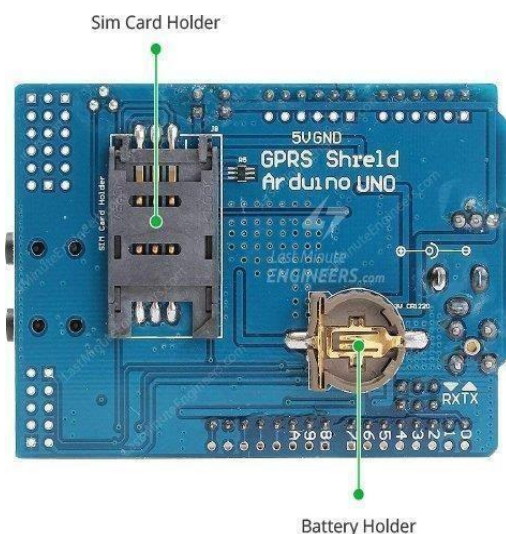


Fig 3.20 Features of GSM (back)

The SIM900 shield packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900

- ☐ Connect onto any global GSM network with any 2G SIM
- ☐ Make and receive voice calls using an external earphone & electret microphone
- ☐ Send and receive SMS messages
- ☐ Send and receive GPRS data (TCP/IP, HTTP, etc.)
- ☐ Scan and receive FM radio broadcasts
  
- ☐ Transmit Power
- ☐ Class 4 (2W) for GSM850
- ☐ Class 1 (1W) for DCS1800
- ☐ Serial-based AT Command Set
- ☐ U. FL and SMA connectors for cell antenna

#### 3.4.6 GPS

##### (a) GPS receiver

GPS, in full Global Positioning System, space-based radio-navigation system that broadcasts highly accurate navigation pulses to users on or near the Earth. In the United States' Navistar GPS, 24 main satellites in 6 orbits circle the Earth every 12 hours.

- In addition, Russia maintains a constellation called GLONASS (Global Navigation Satellite System).
- Long before Global Positioning System (GPS) arrived, researchers worked hard to arrive at a feasible solution to aid travelers from getting lost. Earlier, travelers used to rely on elaborate maps to track and monitor the route to their destination.
- But today, GPS technology has ensured hassle – free trips and increased safety for vehicle owners. The figure below illustrates a GPS satellite in orbit.

(b) *GPS Receiver Module*

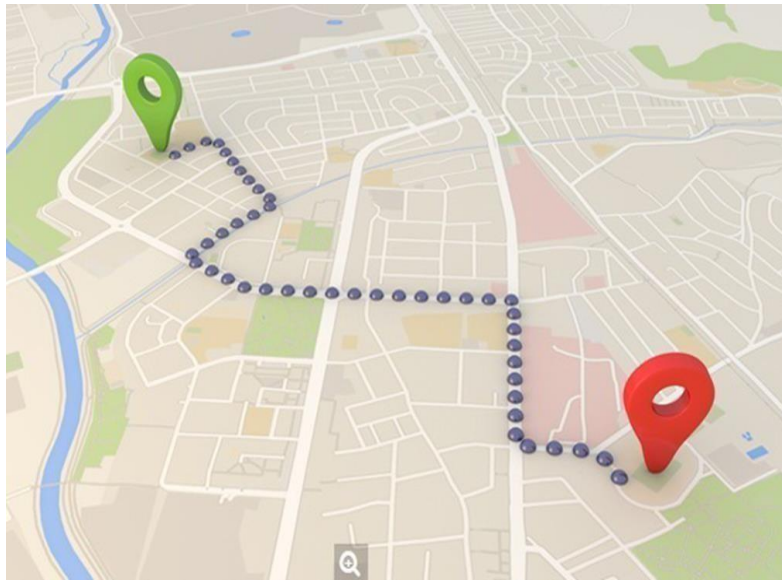


Fig 3.21 GPS receiver module

- GPS receivers are generally used in smart phones, fleet managementsystem, military etc. for tracking or finding location.
- Global Positioning System (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth.
- GPS is also known as Navigation System with Time and Ranging (NAVSTAR) GPS.
- GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information tothe satellites.
- This GPS receiver is used in many applications like Smartphone's, Cabs, Fleet management etc.

(c) *Working of GPS*

- ☐ GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located. These GPS satellites transmit information signal over radio frequency (1.1 to 1.5 GHz) to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time. How GPS Receiver Calculates its Position and Time
- ☐ GPS receiver receives information signals from GPS satellites and calculates its distance from satellites.
- ☐ This is done by measuring the time required for the signal to travel from

satellite to the receiver.

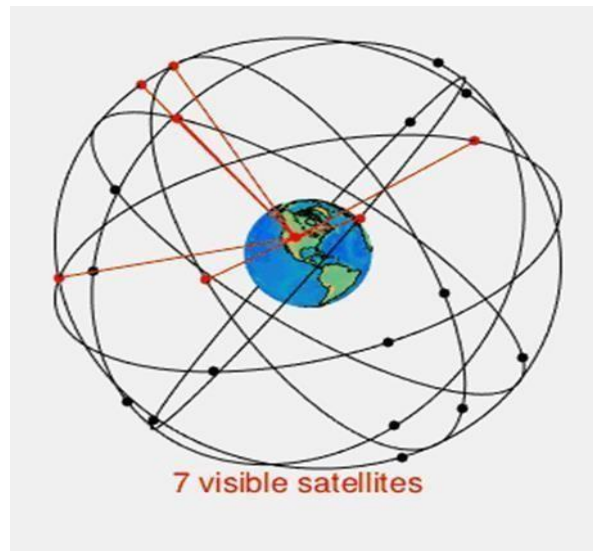


Fig 3.22 Satellites linked with GPS

*(d) GPS Distance Calculation*

Where, Speed = Speed of Radio signal which is approximately equal to the speed of light i.e. Time = Time required for a signal to travel from the satellite to the receiver. By subtracting the sent time from the received time, we can determine the travel time.

*(e) GPS Signal Time Difference*

- To determine distance, both the satellite and GPS receiver generate the same pseudo code signal at the same time. The satellite transmits the pseudo code, which is received by the GPS receiver.
- These two signals are compared and the difference between the signals is the travel time. Now, if the receiver knows the distance from 3 or more satellites and their location (which is sent by the satellites), then it can calculate its location by using Trilateration method.

*(f) GPS Receiver*

- GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on Tx pin with default 9600 Baud rate.
- This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc. Each string

starts with '\$' and ends with carriage return/line feed sequence.



Fig 3.23 GPS module

(g) *GPS Receiver Module*

- ☐ VCC: Power Supply 3.3 – 6 VGND: Ground
- ☐ TX: Transmit data serially which gives information about location,time etc.
- ☐ RX: Receive Data serially. It is required when we want to configure GPS module.
- ☐ Check GPS module
- ☐ Before Interfacing GPS module with PIC18F4550 microcontroller, we can check the output of GPS module. From that string, we can extract information like longitude, latitude, time which is helpful to find location and timing information.
- ☐ To do this, connect this GPS module to the PC via USB to Serial converter or DB9 connector. Also, it is necessary to keep antenna of GPS module proper location.

3.4.7 *Vibration sensor*

<sup>4</sup> This is an SW-420 vibration module, which can work from 3.3V to the 5V. The sensor uses LM393 comparator to detect the vibration over a threshold point and provide digital data, Logic Low or Logic High, 0 or 1. During normal operation, the sensor provides Logic Low and when the vibration is detected, the sensor provides Logic High. There are three peripherals available in the module, two LEDs, one for the Power state and other for the sensor's output. Additionally, a potentiometer is available which can be further used to control the threshold point of the vibration. In this project, we will use 5V to power the module.

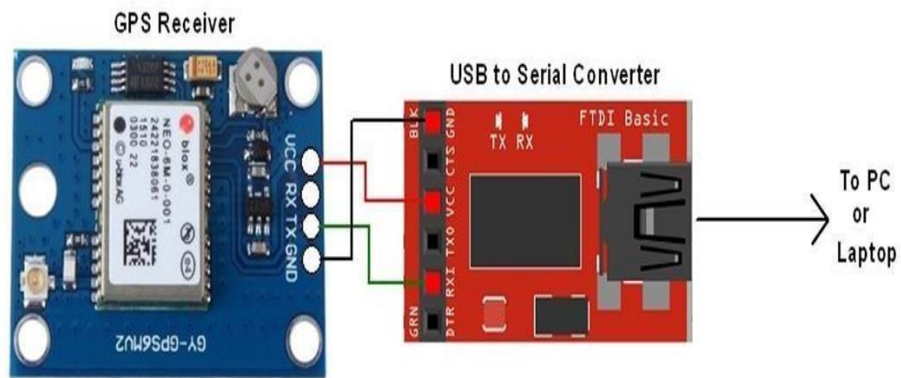


Fig 3.24 Vibration Sensor Module SW-420



Fig 3.25 Vibration sensor

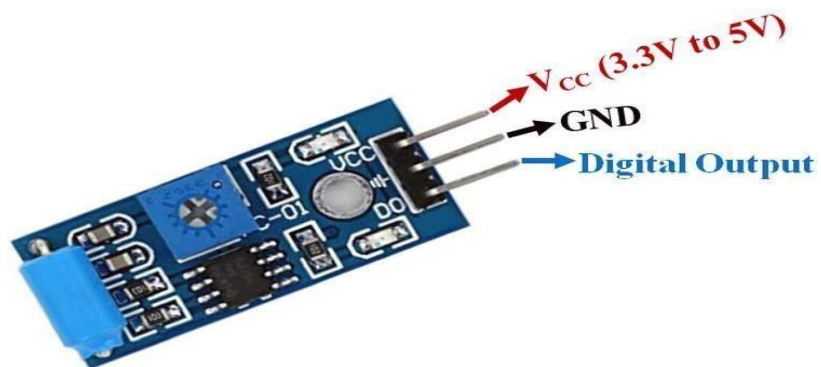


Fig 3.26 Pin Configuration of Vibration Sensor Module

| Pin Name | Description                                       |
|----------|---------------------------------------------------|
| VCC      | The Vcc pin powers the module, typically with +5V |
| GND      | Power Supply Ground                               |
| DO       | Digital Out Pin for Digital Output.               |

#### (a) Vibration Sensor Module Features & Specifications

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15mA
- Using SW-420 normally closed type vibration sensor
- LEDs indicating output and power
- LM393 based design
- Easy to use with Microcontrollers or even with normal Digital/Analog IC
- With bolt holes for easy installation
- Small, cheap and easily available

This Vibration Sensor Module consists of an SW-420 Vibration Sensor, resistors, capacitor, potentiometer, comparator LM393 IC, Power, and status LED in an integrated circuit. It is useful for a variety of shocks triggering, theft alarm, smart car, an earthquake alarm, motorcycle alarm, etc.

##### (i) LM393 IC

LM393 Comparator IC is used as a voltage comparator in this vibration sensor module. Pin 2 of LM393 is connected to Preset (10K $\Omega$  Pot) while pin 3 is connected to vibration sensor. The comparator IC will compare the threshold voltage set using the preset (pin2) and the Vibration Sensor pin (pin3).

##### (ii) Preset (Trimmer pot)

Using the onboard preset, you can adjust the threshold (sensitivity) of the digital output.

##### (iii) SW-420 Vibration Switch

Vibration switch recognizes the amplitude of the vibration to which it is exposed. The switch response can be electrical contact closure or contact

opening. The electrical contact may be either an electromechanical relay or a solid-state device.

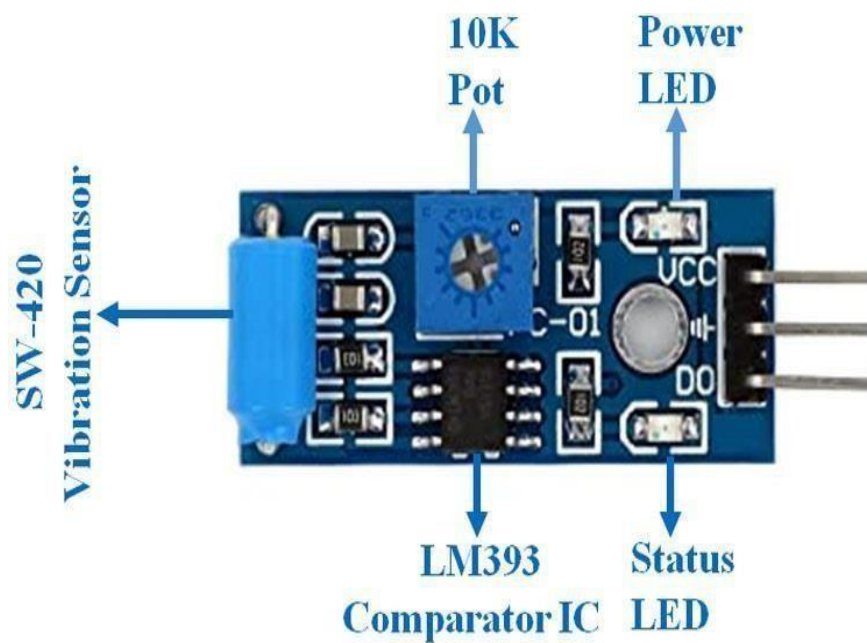


Fig 3.27 Features of vibration sensor

## CHAPTER 4

### RESULT AND DISCUSION

#### 4.1 BLOCK DIAGRAM

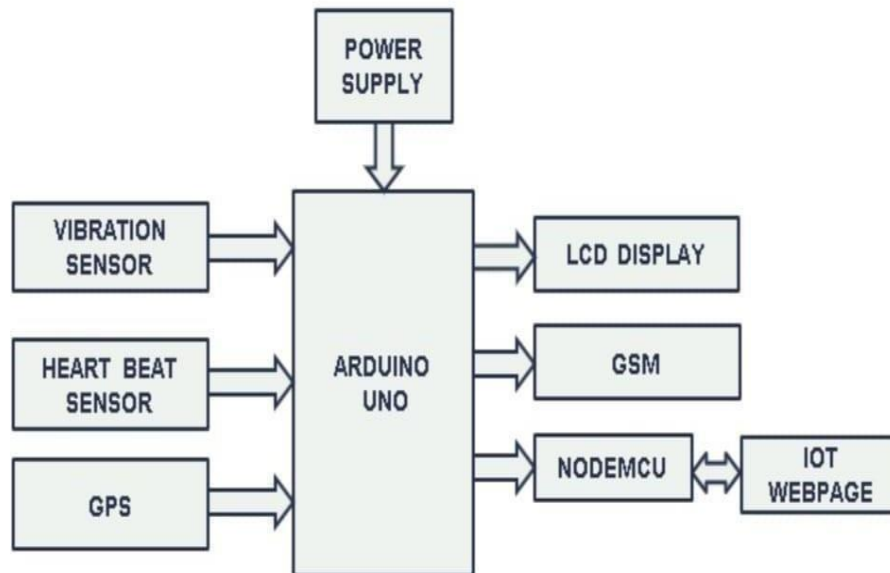


Fig 4.1 Block diagram of the proposed system

##### *Output 1*

All the sensors (Vibration sensor, heart beat sensor,) are collected data 'sand send to Arduino uno.

##### *Output 2*

All the sensors ( gps location ) are collected data 'sand send to Arduino uno.

##### *Output 3*

If any abnormal condition or sensor values reached to threshold limit the GSM will be given a SMS notification to base camp.

#### 4.2 MODULE OF THE SYSTEM

The components of the working system are connected and the following graphs and readings are being observed from the above system.

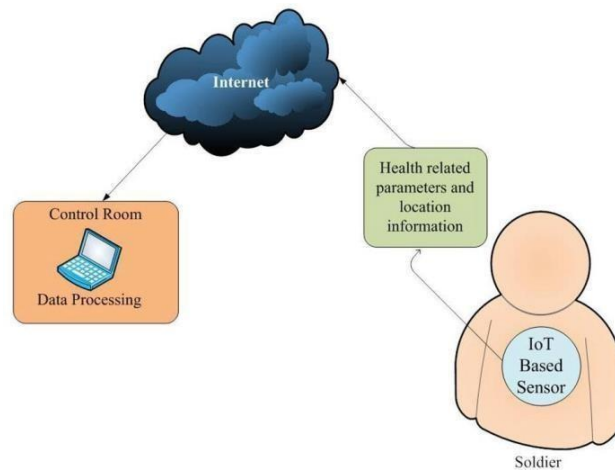


Fig 4.3 Pictorial representation of the system

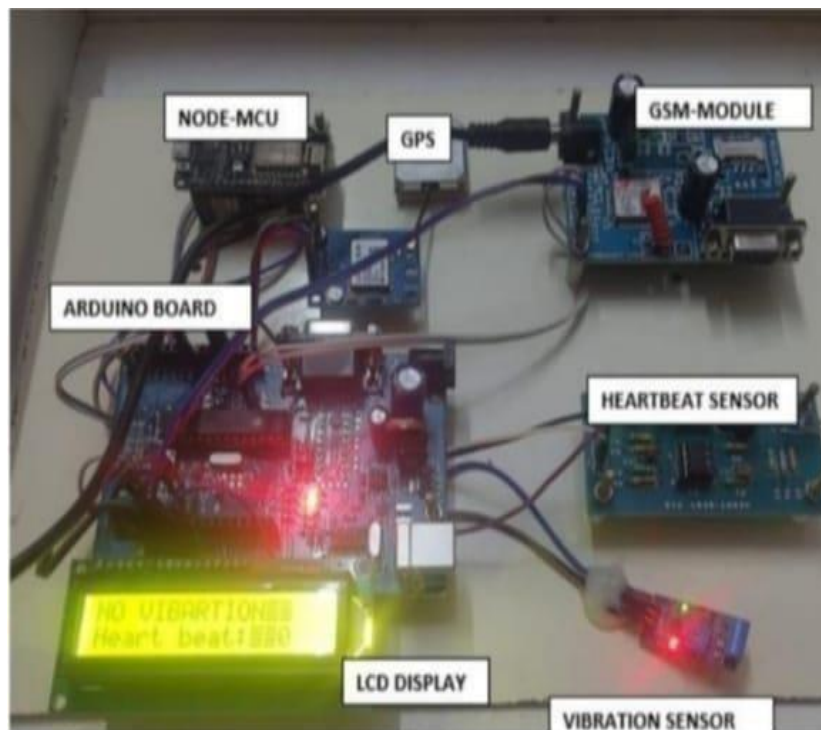


Fig 4.4 Connection of the working system

**(a) Heart beat sensor output**

The graph below shows the reading of the heart beat sensor, here the heartbeat sensors counts the number of heartbeats generated per minute. The heart beat is then shown in the form of graph with respect to the time it was recorded. Below is the flowchart of the working system:

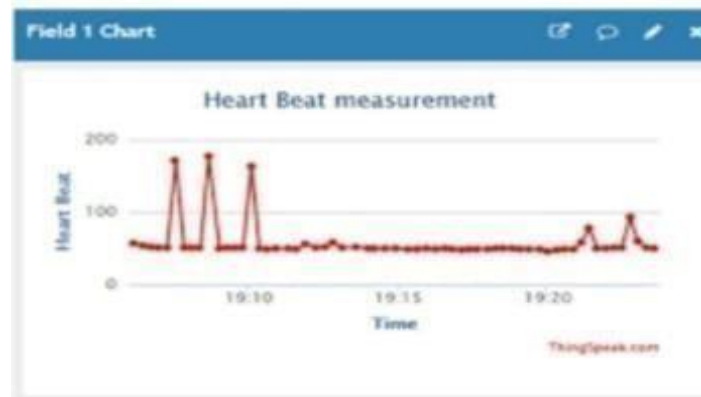


Fig 4.5 Heart beat readings in graph form.

**(b) Latitude and longitude output**

The readings below show the latitude and longitude coordinates of the slider with respect to the time of the recording of the reading. The latitude and longitude change with respect to the movement of the slider. And the readings will be sent to the commander or the control room. Below is the flowchart of the working system

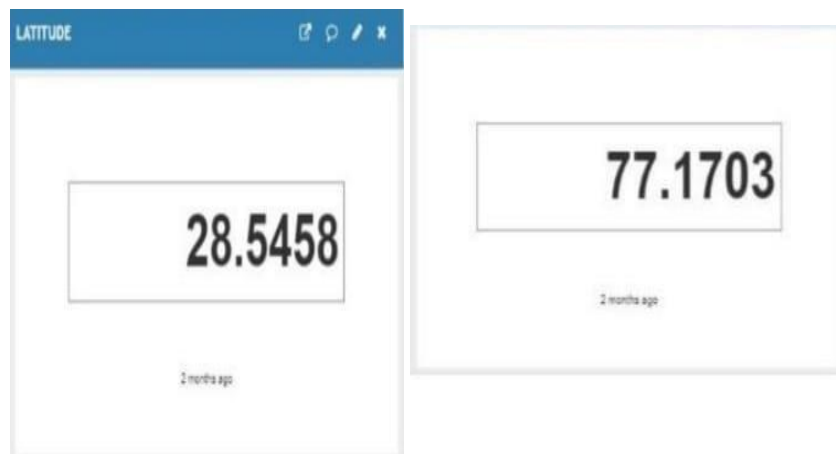


Fig 4.6 Coordinates recorded by the system.

**(c) LCD display and sms output**

The LCD display shows the whether any vibration is detected by the vibration sensor and also displays the heart beat of the soldier. Since this will show the heartbeat of the soldier, it will be easy for them to even check their pulse during combat time. Below is the flowchart of the working system:



Fig 4.7 Heart beat readings displayed on LCD display

The GSM module receives serial data and the sends the SMS to the host server. the text SMS will alert the control room if any vibration is detected.

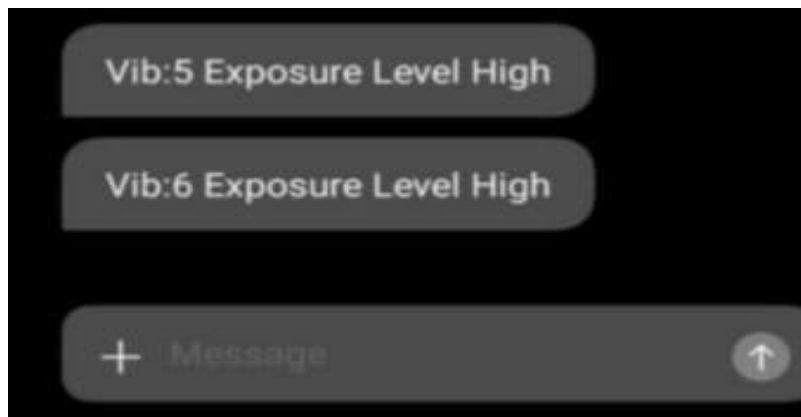


Fig 4.8 SMS generated by the GSM module

## CHAPTER 5

### CONCLUSION

With the proposed project soldiers will be prevented from the risk of any hidden TBI and can be provided with immediate medical assistance. With this system the troop leader can decide which soldier will require an immediate attention to avoid any fatal brain injuries from which the soldier can never recover easily. And the soldier will monitor, according to which he will be appointed to respective missions. The communication range of the device can be increased and the sensors integration can be done in a compact module to be worn in a helmet. The health monitoring sensors can be made into a single module and can be further enhanced by introducing more light weight sensors interfaced with parallel audio and video recording. Instead of mobile notifications to the control room, it can be enhanced by introducing. One of the basic difficulties in military operations is that the soldiers will not be able to interact with the command centre as well as other soldiers. The main duty of army is to protect the nation. As a result, worry for the soldiers' wellbeing is addressed. The study describes an IoT-based system for monitoring and tracking the soldiers' health. Here, we are utilizing an inexpensive Arduino board for possessing purposes.

#### 5.1 FUTURE WORKS

The user may be assisted in making decisions by using a camera that is connected to the microcontroller. The user can also forward the same image to the police station and describe his position if he recognizes an unknown voice or theft-related acts.

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