

## **MEMS based Fall Prediction and Deduction System**

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### ***Abstract***

*Falling is the most risky occasions that a significant part of the time occurs to the oldie individuals, patients who requires restorative thought in particular time. Fall revelation systems would bolster elder people and patients to live sovereignty. A modified constant drop down revelation structure might found drop down events among elderly people at the same time that decrease the extensive mishap rate. This gadget too assists with finding the area .The proposed structure uses the accelerometer and LM35 sensors to structure a continuous fall acknowledgment system further more to perceive temperature worth and heart beat value. With help of MEMS to anticipate if fall has occurred or not ,so it is anything but difficult to stay away from the bogus occasions effectively. The structure consolidates a modified progressing fall acknowledgment contraption, essentialness of sensor centers in an IoT- established fall disclosure structure and skeleton of a balanced sensor hubs messaging limit which can give fall alert.*

**Keyword:** MEMS, TEMPRATURE SENSOR, PULSE SENSOR, NODEMCU.

### **1. Introduction**

MEMS or Micro-Electro-Mechanical Systems likewise alludes to Micro Systems Technology is an innovation of little electronic gadgets generally coordinated with mechanical parts have discovered numerous applications in vehicle industry PC and sound video innovation. One of the instances of MEMS gadget is an accelerometer [Nasiya.PM 2018 & CDC report 2016] which is a combination of electrical and mechanical component which calculates the range of speed powers. These parameters can be stable, analogous to the constant power of gravity pulling at our range; either they could be variable deliver with changing the reading in accelerometer. Another case of MEMS gadget is gyrator which is a gadget for estimating or looking after direction, in light of the standards of rakish energy. Precisely, a gyrator is a turning wheel or circle in which the hub is allowed to expect any direction. In spite of the fact that this direction doesn't stay fixed, it changes because of an outside torque considerably less and an alternate way.

Right now, of these MEMS gadgets will be utilized to build up a fall identification framework. A fall identification framework can be utilized in emergency clinic for checking patients especially for those whom had recently experienced medical procedure. On the off chance that there is any crisis happened to the patient for instance tumble to the ground, a ready framework can help in acquiring consideration promptly to diminish the danger of further injury to the patient.

This ready framework can likewise apply for checking senior resident particularly the individuals who are having strolling challenges.

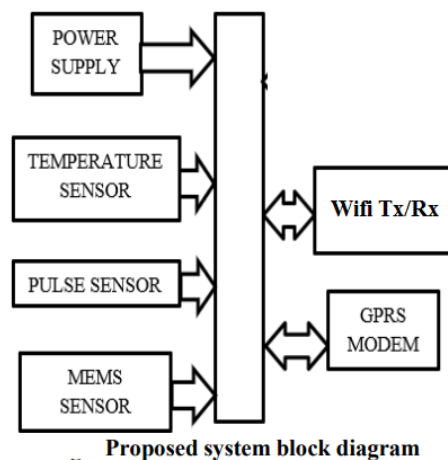
Micro-Electro-Mechanical Systems (MEMS) are mechanical and electro-mechanical elements (i.e., machine and architectures) refined via micro fiction methodology. MEMS, has various names in Europe – MST (Microsystems technology) and in Japan (Micaromachined machine), is not an accurate term to explain MEMS as “electromechanical” modules and/or “systems”. Now many devices has the names and the definition suits to all devices that miniaturises the size ,that is in general 3D Micro circuitries are majorly manufactured by silicon and obtained by isotropic and

anisotropic engraving. The ancestry starts back 1950s for what we known as “MEMS technologies” in the present day technologies. MEMS have first been played in history from a paper by Smith entitled “Piezoresistive effects in silicon and germanium” was published in the international journal “Physical Review”. Wich explains well, force conscious properties in silicon and germanium, named as “piezoresistance”.

## METHODOLOGY

The objective was to plan an accelerometer bit which is little and featherweight that can be well-worn easily beyond blocking typical exercises. The plunge indicator component has two double hub MEMS accelerometers (Analog Devices ADX335E) escalated at right edges to one another, with the end goal that three symmetrical tomahawks of speeding up can be estimated. The ADC in the microcontroller changes over the simple yield of the accelerometers to a whole number in the range [0, 1023], relating to a deliberate voltage of [0, VDD]. Couple of AA batteries power the accelerometer bit, picked for their across the board accessibility and generally minimal effort.

The bit fits inside a plastic box estimating 1/8" x 3/8" x 1 5/8", while the batteries are encased in a different little battery pack marginally greater than the size of the batteries themselves. Initially, the accelerometer bit was expected to be worn on the arm or wrist, like a watch, however past examinations have indicated that the continuous and extreme developments of the arm in ordinary exercises make it hard to utilize the quickening powers saw in that piece of the body to decide the action performed. Different investigations on fall finders have set them on the abdomen for more achievement. The following diagram explains how the structure of sensors and its interfacing, with this an overview of the proposed work can be well defined



### MEMS SENSOR:

MEMS structure additionally framed as miniaturized electro-mechanical structure (microelectronic and microelectromechanical structure) and the analogous micromechatronics and microsystems consists of the invention of plenty of appliances, specifically parts that are having motion property. They had the converge at the very minute that is nano measurable into nanoelectromechanical frameworks (NEMS) and nano techniques. MEMS are additionally pointed to as micromachines in Japan and microsystem innovation (MST) in Europe.

An amount of sections in the dimension 1 to 100 micrometers in capacity is termed as MEMS (i.e., 0.001 to 0.1 mm), and importantly the appliance of MEMS will be in capacity of range 20 micrometer to 1 millimetre (i.e., 0.02 to 1.0 mm), rather than the appliance that masterminded in usage (e.g., computerized micromirror gadgets) can be larger than 1000 mm<sup>2</sup>. [D. Uckelmann et al

2011]. Sensor information's has to be securely transmitted and communicated in wireless manner and the organizing the sensor networks in such a way [C.jeyalakshmi et al 2019] They typically comprise of a focal unit that forms information (a coordinated circuit chip, for example, microchip) and a few segments that associate with the environment, [F. Bonomi 2012] (for example, microsensors). Iris recognition has been considered as sensor information.[B kiran bala 2017] Because of the huge surface territory to volume proportion of MEMS, powers created by surrounding electromagnetism (e.g., electrostatic charges and attractive minutes), and liquid elements (e.g., surface strain and thickness) are more significant plan contemplations than with bigger scope mechanical gadgets.

The capability of extremely little machines was acknowledged before the innovation existed that could make them (see, for instance, Richard Feynman's popular 1959 talk There's Plenty of Room at the Bottom). MEMS became handy once they could be created utilizing adjusted semiconductor gadget manufacture advancements, typically used to make electronics.[ L. Atzori, et al 2010, D. M. Gaba et al 2010] These incorporate trim and plating, wet scratching (KOH, TMAH) and dry carving (RIE and DRIE), electrical release machining (EDM), and different advances fit for assembling little gadgets. The picture of MEMS sensor is shown below.



MEMS SENSOR

LM35:

Hotness, coldness to some degree can be calculated using a component termed as LM35 with a smooth production of voltage corresponding to the temperature. It gives yield voltage in Centigrade (Celsius). It doesn't require any outside alignment hardware.



LM35 Temperature sensor



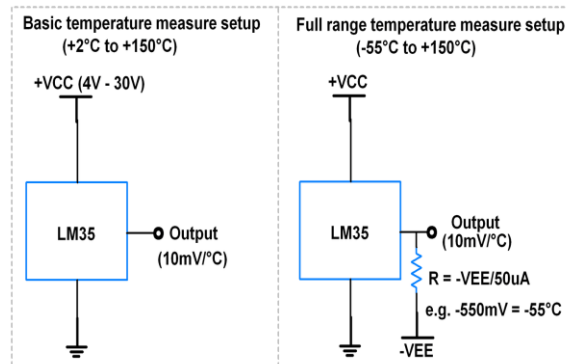
Pin description – LM35

The affectability of LM35 is 10 mV/degree Celsius. As temperature expands, yield voltage likewise increments. For example 250 mV implies 25°C. It is a 3-terminal sensor used to quantify encompassing temperature running from - 55 °C to 150 °C. LM35 gives temperature yield which is more exact than thermistor yield. The picture and pin description of LM35 temperature sensor has depicted for more clarity.

VCC: the Supply Voltage lies in between 4V to 30V

Out: It provides analog values as resultant voltage that is comparable to the hotness and coldness values. (in degree Celsius).

GND: Ground



### Application Setup

The application set up clearly depicts the work it going to be done in the application and the temperature range of measurement has two ranges +2 to +150 in degrees Celsius and full range of - 55 t +150 in degrees Celsius.

HEARTBEAT SENSOR:

Pulse is a window into your muscles and lungs as it uncovers how hard they are functioning! The requirement for an exact, yet reasonable heart screen is fundamental to guarantee ones wellbeing quality. So here's a prefatory article to enable you to configuration/construct a minimized and cost-proficient pulse (beat rate) screen that will give a precise perusing of one's pulse. Keep in mind, your pulse is an excellent pointer of your physical condition. The picture of sensor is shown below for visual clarity.

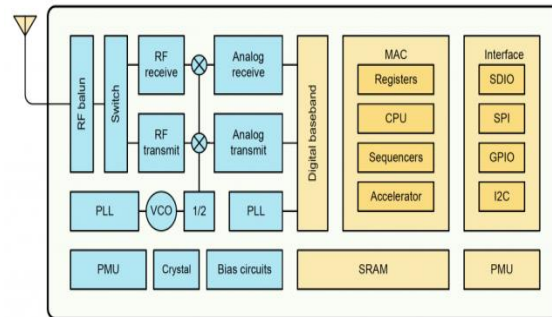


Heart Beat sensor

NODE MCU:

Despite the fact that it's amazing, the NodeMCU ESP8266-12 constraints can back you off.

As of late, there have been doing a great deal of work with the NodeMCU ESP8266-12E improvement board. Similarly as with past ESP board forms, seeing great documentation proceeds as trying. While the first ESP6266-01 module just had two GPIO (broadly useful info yield) sticks, this most recent cycle has some more. Be that as it may, what number of something else? While the fundamental Espressif chip has 17 GPIO, they are not completely uncovered or accessible on the advancement board. Also, a large number of them are shared or multiplexed with other advancement board highlights. This implies they are not accessible for program use, or just accessible here and there. Actually, this board has four diverse utilitarian modes which are avoided the client and utilize the pins in various manners for every mode.



Block Diagram For Node MCU

The block diagram of Node MCU ESP8266-12e has been shown and it has important limitations such as it will mostly affect GPIO.

Based on the work and its nature of perusing and experimentation, here is the thing that is found out about NodeMCU ESP8266-12E impediments with GPIO pins. The essential pins for computerized information and yield are D0..D8. These likewise support Arduino style pin intruders, aside from D0, which can't bolster PWM either. D9 and D10, likewise marked RX and TX on certain sheets, are additionally utilized for sequential correspondences, including stacking programs onto the gadget. I have understood that if your program doesn't utilize sequential correspondences, you can likewise utilize D9 and D10 as computerized I/O. In any case, I have not had the option to get this to work dependably. If you are utilizing equipment Serial Peripheral Interface Bus (SPI) to speak with peripherals, pins D5. D8 become inaccessible, as they are utilized for equipment SPI. For instance on the off chance that you are utilizing SPI with two peripherals, you tie up 8 pins: D5. D8 for the transport, two additional pins for select, and two additional pins for control. Some experimenters state that they have utilized GPIO9 and GPIO10 for info and yield, separately. Be that as it may, not me. Also, recollect that certain GPIO (0, 2 15) must be in explicit states during boot and blaze. Another constraint in the event that you are not cautious.

ESP8266 ARDUINO CORE :

As in ARM / SAM MCU employed in the Aurdino Due, an advanced MCU sheets dependent on non-AVR processors as new MCU sheets termed Aurdino.cc was established with increasing demands , they were awarded to adapt the Aurdino IDE with an aim to alter IDE to aid interchange components to accept Aurdino languages to be made used to these advanced processors. A demonstration was done with board manager and SAM core. An incorporation of Aurdino C/C++ languages and their source scrape was needed to the objective MCU's low level languages , hence “ Center “ an assortment segments in programming needed by the board manager and Aurdino IDE

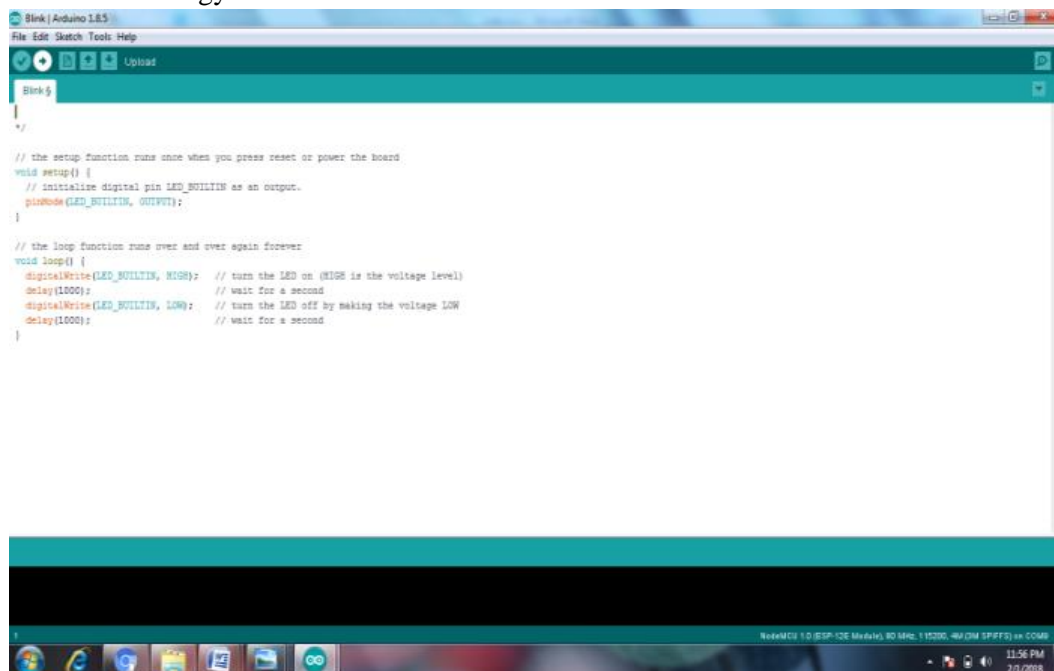
was designed . Some innovative ESP8266 fans have built up an Arduino center for the ESP8266 WiFiSoC that is accessible at the GitHub ESP8266 Core site page. It is what famously termed as “ESP8266 core for Aurdino IDE”, which has gotten many programming advancement levels for different ESP8266 based modules and requirements including node MCU

While the hidden Espressif chip has 17 GPIO, they are not completely uncovered or accessible on the improvement board. What's more, a significant number of them are shared or multiplexed with other improvement board highlights. This implies they are not accessible for program use or just accessible now and again. Truth be told, this board has four diverse practical modes which are escaped the client and utilize the pins in various manners for every mode.

## RESULTS AND DISCUSSIONS

The result is obtained by the program written in embedded c and is run by Arduino IDE, in this ESP8266WiFi.h file is used as header file. In this header file ESP8266WiFi is represented as nodemcu's pin number. From the below mentioned figure a part of entire program is mentioned which is specifically explaining the working of MEMS sensor. This program is loaded and executed into the MEMS sensor and it will show the result about patient's position i.e. whether the patient is fall down or not. Further coding is written to find the patient's temperature, heartbeat, and location using various sensors which are explained earlier in this article. These information's are accessed by a dedicated IOT server for remote access, though cloud storage methodology.

In this process, a local sever is used and the mobile phone is acting as a local server, the mobile phone (server) need to switch on the hotspot to enable its serve capability and another receiver network should connect the wifi technology to access using server's ID name and password. Dedicated IP address is used to keep the patient detail safe and secure. As soon as the access through the IP address is achieved in receiver side it starts receiving information about the patient as an output of this methodology.



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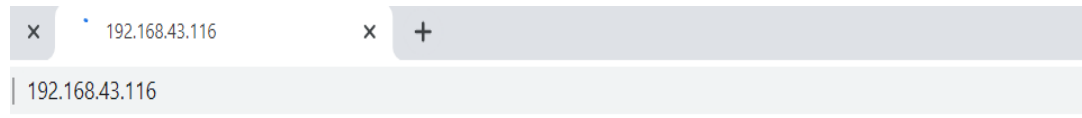
// Blink
//
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
  delay(1000); // wait for a second
  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
  delay(1000); // wait for a second
}

```

PROGRAM for ESP8266 NODE MCU

In the below mentioned figure an model output of a patient is explained which shows the health condition that includes body temperature ( both in degree celcius and in farenheat) , the position which indicates weather the patient is fall down or in normal state which includes the latitude and longitude information , then heartbeat level . In the output since the has not fall down so the (FALLING STATUS LEVEL: NORMAL) along with that it shows the (HEART BEAT LEVEL: NORMAL), (TEMPRATURE = 99.35F), From this output we will be knowing that the patient or elder people health condition is normal.



## FALLING DETECTION SYSTEM

Temperature (\*C)= 37.42

Temperature (F) = 99.35

FALLING STATUS LEVEL :NORMAL

HEARBEAT LEVEL : NORMAL

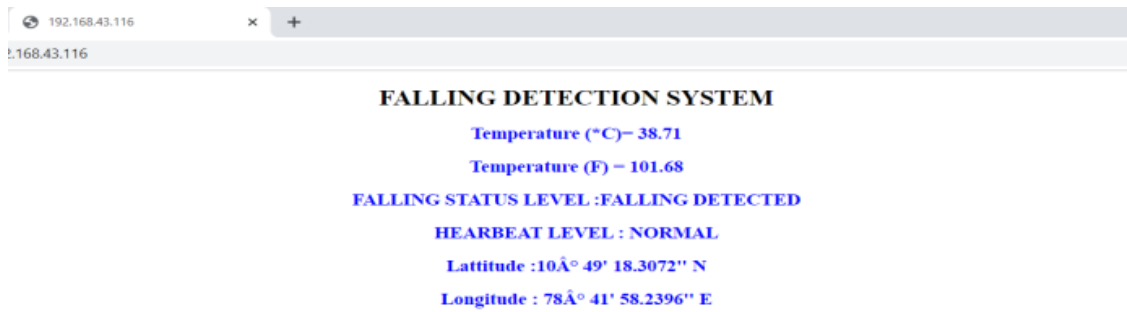
Lattitude :10° 49' 18.3072" N

Longitude : 78° 41' 58.2396" E

### Normal Patients Result

In order to ensure the patients stability in a periodic manner the positional information needs to be verified in periodic basis hence once in every 5 seconds the output will be refreshed. The below mentioned output screen shot is taken after 5 seconds to find out the patients position and health condition. The output shows that the patient is fall down so the (FALLING STATUS LEVEL: FALLING DECTED) and it also shows the (HEART BEAT LEVEL: NORMAL), (TEMPRATURE = 101.63F), From this the patient or elder people health condition is identified as ubnormal. It has an defect that if the patient intends to take any thing from the floor it will be spotted as falling action and the sensor output will be like FALLING DETECTED , hence to improve the accuracy and to overcome this problem the result will be refreshed every 5 seconds, hence if the patient is really fell down the results will be in FALLING DETECTED for a while and the patient will be identified ubnormal , By this way we can clarify the patient's condition. The future scope of this work will extends and plan to include to identify the motions of the patient and the iris recognition along with the image processing techniques to exactly identify the problem of the patients in critical and remote conditions.





Result after refreshing (every 5 seconds)

## CONCLUSION

There are differing fall zone structures that limits major for the affirmation, but still it is has not been feasible for infant snatching scheme in the truth, because of the more noteworthy number of sensor centres related with mortal with lopsided wearing condition. The suggested structure is designed to be beneficial, wearable contraption set on the midriff of client, having sensors including accelerometer and tilt sensors and an essential figuring utilizing position affirmation fall area. At the present time, imperativeness utilization of remote sensor centre points in fall recognizing evidence was discussed. IoT-based framework for perceiving an imperativeness sufficiency technique for orchestrating those sensor centre points was described. Furthermore, we clarified a reasonable balanced sensor place point for accomplishing an enormous level of imperativeness usage. Veered from essential imperativeness utilization of two or three sensor community focuses dependent on this close by different plans accepted that sensor place is essentialness beneficial.

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