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Personal Health Monitoring Device for Dependent People

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Abstract: ***A great demand of modern earth is to get everything within a very short time. At present situation, people want to realize their current health condition and also want proper care rapidly. But older and disabled people are very incapable without someone's help. Even they have to face so many difficulties to inform someone about their health condition. To solve this problem a smart and automobile system has been proposed. The proposed system consists of health monitoring systems with body temperature and heartbeat measurement. This project describes a technique of a developed mobile device that can monitor heart rate, detect missing heart beats and send the heart rate and missing beat information via GSM to a remote person or physician as well as our device will work as pedometer. The major pros of this wearable over other wearable are that it can be used in any cell phone and doesn't necessarily require an expensive smartphone and not a very techie individual to operate. The purpose of this device is to help the parents to locate their child or elders with ease.***
Keywords: Temperature & Heart Beat measurement, Fall Detection, GSM, GPS, Blood Pressure, LiPo battery.

I. INTRODUCTION

It is important for every person in the world to keep their health secured from every possible danger. But older and disabled people are facing lot of difficulties to look after their own health. Because of some physical weakness, they need extra care and support. For that reason, elder and disable people need something that helps them to monitor every second.

World Health Organization (WHO) has classified the fall as the second largest (unintentional) cause for injuries causing death. Every year, approximately 645 thousand individuals lose their life due to the fall worldwide in which 80% are from low to middle income countries. They have defined a fall as an unexpected, uncontrollable and involuntary cause resulting a person to impact on the ground or some lower level. The damage is dependent on the height difference and angle at which the person fell.

In this modern and fast-moving world, the elderly's safety and security have become an important issue. In 2015, there were 12.3% population aged 60 and above globally and it is the fastest growing population at a rate of 3.26% per year. The emergency impact that occurs among the elderly people may not be noticed timely by the caregivers, such as falling down to the ground. To reduce the worries about elderly who live alone at home, Elderly Fall Detection and Location Tracking System (EFDLTS) is required for continuous monitoring. Maintaining the temperature of the body is an important part to look after one's health condition. Especially for older people because if their temperature is increased then they might suffer from stroke. On the other hand, disable persons are facing weakness, fever, etc. problems. Moreover, for human being temperature of the body can be changed anytime. The proposed system is aimed to deliver a real-time monitoring facility so that the timely medical attention is given to the victim in the case of fall and also the proposed system will record the real time pedometer monitoring. Blood pressure is also related to the temperature. If the temperature is increased then the blood pressure will also increase, which can be very harmful to the elder and disable people health. There are lot of reasons behind the changes of rate in blood pressure. Higher Blood pressure can cause the stroke. For low pressure, they are facing like cadences, fisting etc. problems. For measuring the blood pressure, a device will be implemented here, which can measure their heart rate 24hours. It also can send alarms to their caretaker in case of emergency with the help of GSM.

Also one of the biggest problems of elderly and disabled person is fallen down. Due to their weakness and other physical problem they sometimes face this problem, for this the device will be designed which will notify their position to their caretaker in case of emergency with the help of GSM. In modern world, Concerned person can monitor the health Elderly Person or Children or Disabled person only when they are with them or elderly person can monitor their health themself, when they are outside. If victim is facing any difficulties in health problem immediate action cannot be taken unless or until someone helps them. The cost of existing system device is high cost. Concerned person can get information when the Elderly Person or Children or Disabled person faces any difficulties in health and also counts the step. If victim faces health problem, automatic intimation device will be designed such that it will send health information to concerned person and hospital. The proposed system is Cost Effective.

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II. OBJECTIVE

The main objective of my project is to develop a smart device which will be helpful for dependent people and help in time to time monitoring of health condition.

III.SYSTEM DESIGN

A. Block Diagram Explanation

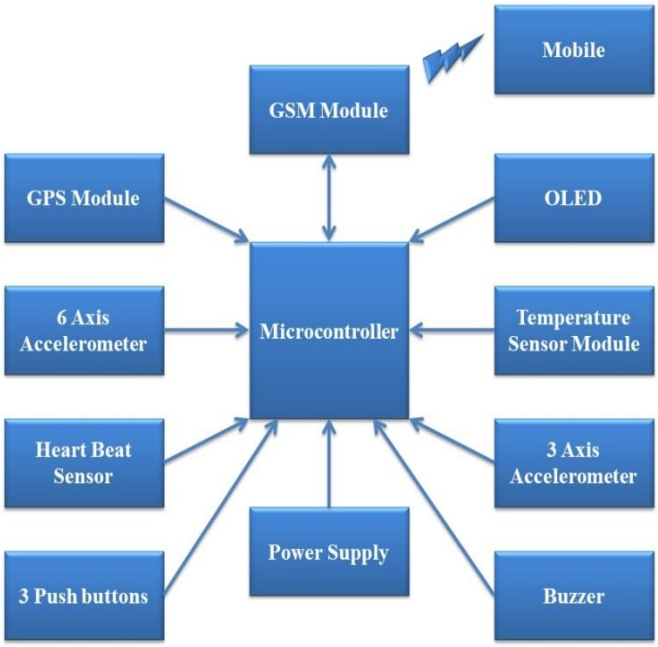

Fig. 1 Block Diagram of Proposed System

Fig 1 shows the block diagram of proposed system, it consists of Microcontroller, power supply, heart beat sensor, temperature sensor, 6 axis accelerometer, 3 axis accelerometer, GPS module, GSM module, OLED display, buzzer, 3 push buttons and mobile.
The proposed system works in such a way that if any victim faces any health issues but there is no one to help, this module helps in sending the message about status and location of victim to concerned person and nearest hospital. The location can be tracked using GPS module, the 6 axis accelerometer helps in position of victim such that he is fallen down due to unconscious or weakness and 3 axis accelerometer helps in detecting the steps count, switches helps in change the display and also to send message during emergency. The device is also designed in such a way that if the victim faces any high or low blood pressure and any temperature changes in the body. The optioned data will be sent to concerned person and hospital along with position.
The 7.2V battery is used to supply for microcontroller and other devices, 7.2v is converted to 5v voltage using Buck Boost Converter and voltage regulator. Microcontroller works as heart of our module, which controls the sensors based on requirements, each device is connected using Digital, Analog pins SCL & SDA pins. Heart beat sensor is designed to give digital and analog output of heart beat by placing it on wrist. When the heart beat detector is working, the beat LED flashes in in concert with each heartbeat. This digital and analog output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. Temperature sensor is used to measure the temperature of a candidate. Even in high sweating the device works perfectly since we are using water proof sensor. Temperature sensor works on the principle of direct conversion of temperature into a digital value. Its main features are to change its bit numbers according to change in temperature. Organic Light Emitting Diode (OLED) display is used to display time, date, temperature, heart rate and status of user. Global Positioning System (GPS) Module to sense and identifies locations anywhere in the world. That is capable of receiving information from GPS Satellites and then to calculate the device's geographical position. Global System of Mobile (GSM) Module is used to send short message service (SMS) about health condition of user, our project will be designed such that the SMS will be sent to three contacts. 6 axis accelerometer is used to detect the fall of person using accelerometer and gyroscope. 3 axis accelerometer is used to detect the setups count of person, using the number of steps, calories burnt and kilometre walked is calculated.

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B. Flow Diagram Explanation

The flowchart of proposed system is shown in Fig 2, soon after turning all the devices the GPS location will be tracked, and time and date will be displayed along with location, then the device will start checking Heartbeat and BP every minute, in-between every minute time, date and GPS will be updated along all this our device will check for pedometer and fall detection. If fall occurs then, the message will be sent along with Heartbeat, BP and temperature of victim. If a person needs emergency he can send SMS which contains help and location message. High temperature, High Heartbeat message will be sent to the concerned person. Since we are using 128*64 OLED displays, the display content will be changed whenever the particular button is pressed.

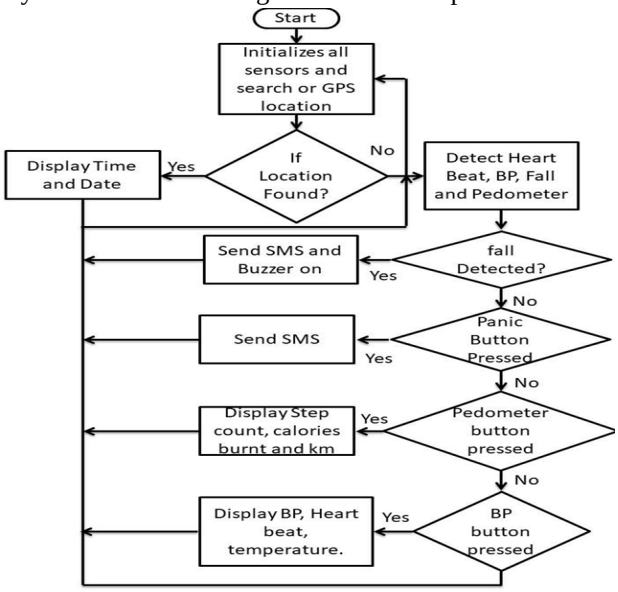

Fig. 2 Flow Diagram of Proposed System

Many algorithms have been developed but till now it is difficult to distinguish real falls from certain fall-like activities such as sitting down quickly and jumping, resulting in many false positives. Most of the algorithms use accelerometer to detect fall with body orientation, but it is not very useful when the ending position is not horizontal, e.g. falls happen on stairs.

We made a novel fall detection system using both accelerometers and gyroscopes and for that my algorithm reduces both false positives and false negatives, while improving fall detection accuracy. My system instantly notifies to a concern person with SMS when fall occurred. Our algorithm is based off the concept that during a fall, a person experiences a momentary free fall or reduction in acceleration, followed by a large spike in acceleration, then a change in orientation. We see the algorithm checks to see if the acceleration magnitude (AM) breaks a set lower threshold. If this lower threshold is broken, the algorithm then checks to see if AM breaks a set upper threshold within 0.5s. If this upper threshold is broken, the algorithm then checks to see if the person's orientation has changed in a set range within 0.5s, which would indicate a person has fallen or toppled over. If the person's orientation has changed, the algorithm then examines to see if that orientation remains after 10s, which would indicate the person is immobilized in their fallen position on the ground. If this holds true, the algorithm recognizes this as a fall. A failure of any of the intermediate decision conditions would reset the triggers and send you back to the start. The strength of this algorithm is that it requires an activity to break two AM thresholds and have an orientation change. Ideally this additional lower threshold would reduce the number of false positives. The weakness of this algorithm is that it requires the fall to involve an orientation change.

Initially the blood flow is measured and it is fed to heart rate sensor (IR transmitter). From this the heart rate is calculated per minute, this value is fed to the microcontroller. The cardiac output is measured by multiplying the stroke volume and heart rate. When the resistance is calculated the blood pressure is measured directly. The blood pressure is the product of cardiac output and resistance.

1) Formulas

a) Stroke Volume: π*(LOVT dia)2 / 2 * LOVT VTI.
b) Heart rate: Beat/min.
c) Cardiac output: Stroke Volume * Heart rate.
d) Resistance: MAP * 80/Cardiac output.
e) Blood Pressure: Cardiac output * Resistance.

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A pedometer is a device, usually portable and electronic or electromechanical, that counts each step a person takes by detecting the motion of the person's hands or hips. We are taking hands acceleration in x and y direction to detect steps. Place accelerometer such that Z-axis is perpendicular to Arduino Mega and X-axis and Y-axis is parallel to Arduino Mega.

Finding the range of acceleration values in which our hand moves is really difficult task. Because when we upload the code to Arduino Mega we may little displace the accelerometer because of inserting and removing pins. If it is displaced little bit. Accelerometer changes its values. So we need to make sure accelerometer is firmly placed on Arduino Mega, and also make sure we don't close the pins of Arduino Mega where we will upload the code.

Find the range of x and y value when your hand is still. This range will not be inserted in the code. But we need to find it out because we will get an idea. When our hand is moving forward then x and y value is increasing or decreasing. Move our hand in forward direction and note the values in x and y direction.

Similarly find the range for x and y values for backward direction. Depend upon your still hand values, use <=, >= this condition.

2) *Pedometer Steps to Calories Converter:* We can use your pedometer steps to calculate your calories burned walking. our calories per step will depend on your weight and height. A typical 160-pound person of average height will burn about 40 calories per 1,000 steps. This is the equivalent of 0.04 calories per step. For Height 5'6" to 5'11" and 64Kg, calories burnt for thousand steps are 35. So 1 step burns 35/1000=0.035 calories. Average distance of persons step is 60cm. So we can calculate distance by multiplying it with steps count.

a) *Calories:* count * 0.035.

b) *Distance:* count*0.0006.

IV. RESULTS

Personal Health Monitoring Device for Dependent People was successfully developed which can display Heartbeat, BP, Temperature, Time, Date, Steps count and calories burnt and it also sends SMS in all conditions. The Fig 3 are the results we obtained. The device displays soon after it is turned on, our device will search for GPS location, until it finds the location "Trying to locate GPS Satellites… Please wait" message will be displayed during this time heartbeat, temperature, pedometer works as usual, we can obtain these results. Soon after it finds location, our device will display time on top right corner, the time displayed will be in the form of 24hours clock and format will be HH:MM:SS. At the top left corner, date will be displayed; its format will be D/M/YEAR. Below time and date it will shows location in the form latitude and longitude. The Temperature is displayed in the form of Celsius. Below temperature it displays heartbeat/minute mentioned as BPM (Beats per Minute). Below BPM, BP is measured and displayed in the form of SYS/DIA. The device displays status of temperature and BPM, it display weather the obtained temperature and BPM is low or high compared to normal range. In this case the obtained is high BPM and temperature in Low. The device displays status of step count; it displays the number of steps walked along with calories burnt from our step and distance covered in km while walking.

Fig. 3 Results of Proposed System

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Our device prototype model shown in Fig 4 can be wear in our hand as watch; this device is designed to wear in left hand.

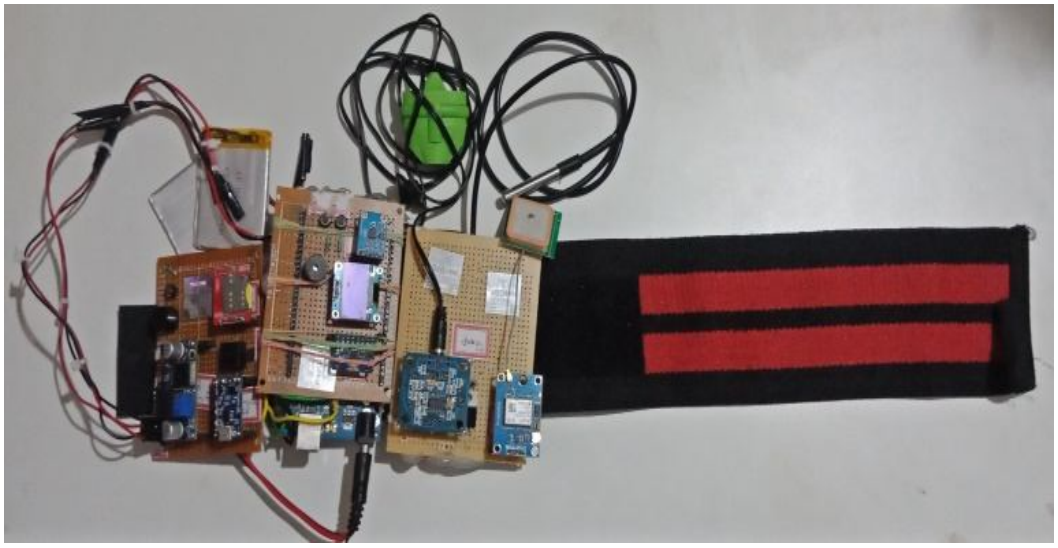

Fig. 4 Prototype Model of Proposed System

Below images from Fig 5 shows the different messages we receive from our prototype. We get three types of message patterns, the 1st message pattern of emergency, i.e., when user needs any help he can use panic button, device will send location of user to concerned person. The 2nd message pattern when device reads High/Low BPM and High/Low Temperature. The 3rd message pattern when the user experiences any fall from health issues, this message will be sent to 3 concerned persons like doctor, concerned person and ambulance services.

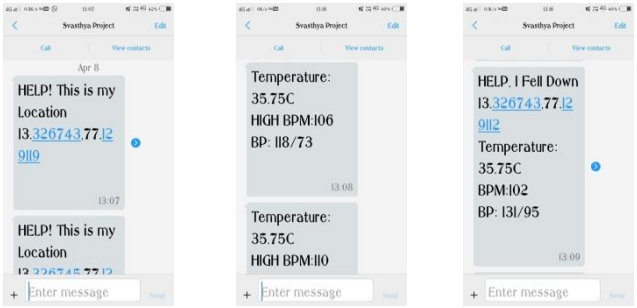

Fig. 5 Messages from Prototype Model

V. CONCLUSION

The main purpose of this project was making life easier and self-dependence of elderly and disabled people. Another purpose was producing them rapid support at the bad condition and primary health hazard. This project has fulfilled the goal completely. The sensor data was more accurate in closed place of the body than the open place of the body. Without any network, problem GSM sends a notification to respective person within a very short time. So compare with cost and efficiency this system can be a good peer of old and disable person's life. In this project size can be reduced with detailed design and it can be designed such that along with SMS a pre-recorded voice can be sent, and also a status request option can also be implemented.

VI. ACKNOWLEDGMENT

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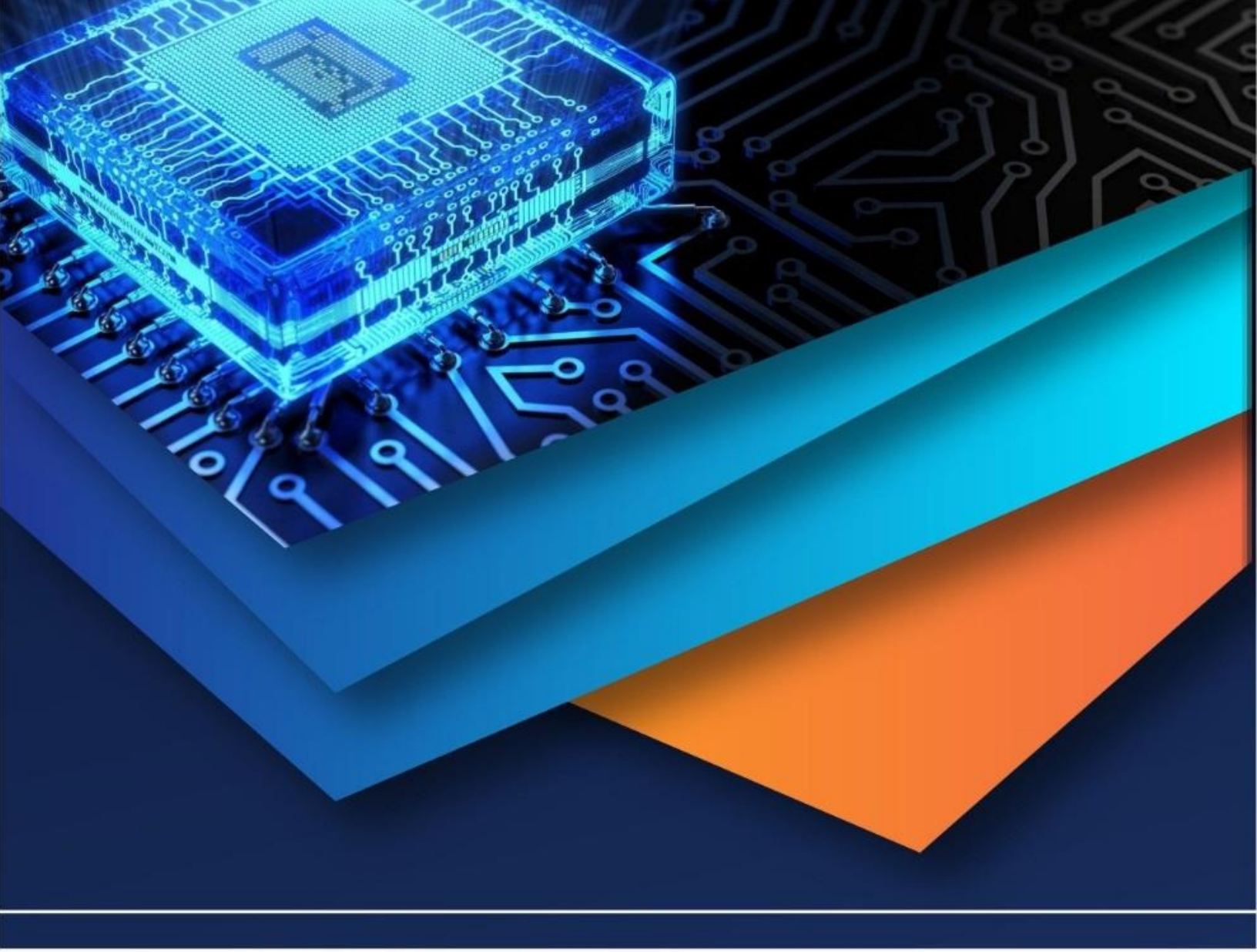

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