Smart Wearable Obstetric Assistant and Reminder

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Abstract—The purpose of this project is to design a smart system that uses noninvasive techniques in recording the frequency and duration of labor pain during pregnancy so as to assist the expectant person in determining the time when she must start from home to go to the hospital and for how long the doctor can safely delay the delivery after arriving at the hospital. There are various other difficulties faced by the women during pregnancy. Here we wish to outline few of these difficulties and through this project we would try to suggest few remedies for them. The device will be synchronized with the concerned doctors system using the concept of Tele-medicine and thus it will provide the user with a friendly interface through which the exchange of important information can occur between the user and the doctor at several instances during the gestation period. The device will also measure the pulse rate and the temperature of the user's body and regularly update the information to the doctor's system which can be analyzed for any abnormalities. We also have the GSM modem embedded in the system that can send various indications such as emergency, panic, slip/fall etc., in the form of a text message onto the expectant women husband or on any other family member's number as fed in the system so that they can aid her in case of need. It will also aid in calling for an ambulance service in case of emergency. With the help of the GPS antenna used in the device we can also be able to track the location of the user on the Google maps application. Apart from being used by the women during the pregnancy, this device can be used by old-age people for similar problems such as emergency, panic, fall, temperature and pulse rate measurement, etc.

Keywords- Pregnancy, Tele-medicine, gestation period, GSM modem, GPS antenna, Google maps application.

I. INTRODUCTION

In the past few decades we have witnessed a rapid growth in the field of science and technology, and evidently there has been a tremendous advancement in the Health Care Systems. Technology now provides us with various innovative methodologies to carry out the most complex operations in a simple and sophisticated manner. Few such methodologies in the fiel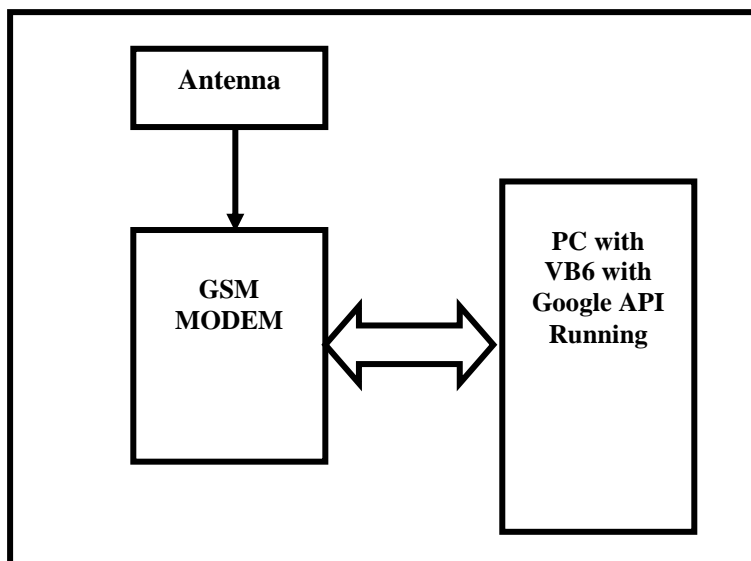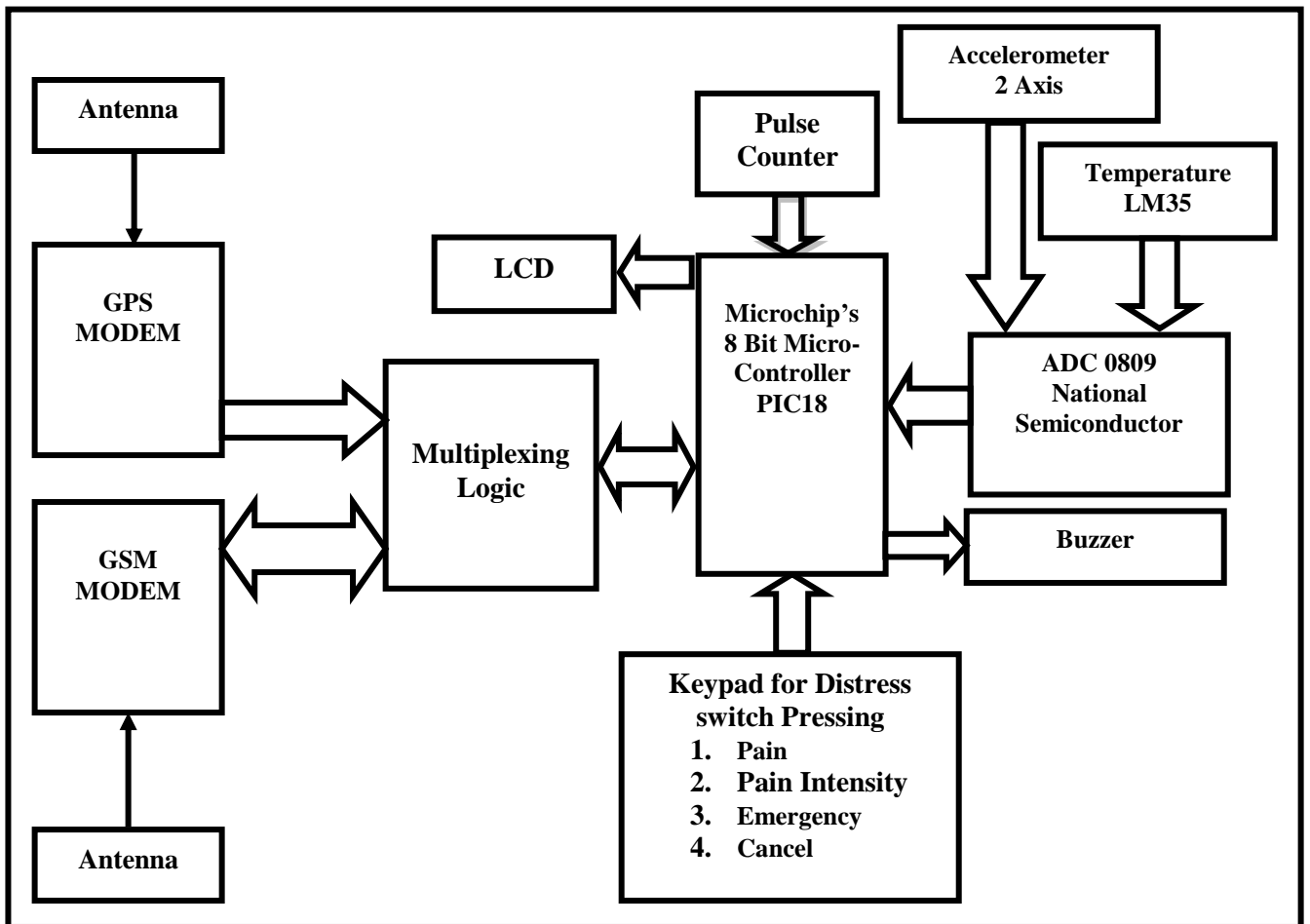d of health-care include wearable technology like Google glass, Optogenetics, Digestible sensors, Tele-medicine, Intra-operative surgeries, etc.

Due to busy lifestyle and different sort of involvements in today's world, it is difficult to commune frequently from one place to another. Pregnancy is an important phase in a woman's life. During these 9 months gestation period, she may have to get routinely checked up by the doctor. This check up might be as often as every 15 days. Considering the difficulties that might be faced by a woman in taking an appointment from the doctor and in travelling all the way to hospital, we try to design a smart system, that will avoid unnecessary travelling of the pregnant woman to the hospital, by using the concept of Tele-medicine.

Tele-medicine is defined as the delivery and sharing of medical information of patient over a distance using communication over networks. Thus, using this concept the distance barrier between the doctor and the patient can be reduced. Existing Tele-medicine systems only exchange the information in the real time with fixed location, or with a bounded location or pre-configured location. Using portable devices, Tele-medicine service is feasible even on the move.

We propose a wearable mechanism that would be preferable when the user is actively working or when he/she is on the move. The system is designed using less expensive and user friendly components, as will be discussed in the following sections.

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II.   Block Diagram

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The block diagram is as shown in the above figure. The device is intended to perform different kind of functions. It involves a number of hardware parts which are operated in a sophisticated manner using the software's developed for the respective purposes. The hardware and the software parts can be listed as follows:

Hardware Part:
- PIC 18 Microcontroller
- GPS Modem
- GPS Antenna
- GSM Modem
- 1:2 MUX

Software Part:
- PIC 18 Embedded C coding for MPLAB
- Visual Basic6 for the GUI on the front end of the system.
- Google Map API connectivity.

We are making use of a PIC18 microcontroller. It has various advantages over the low cost 8051 microcontroller and the most expensive Raspberry Pi. Few advantages can be listed out as follows,
- It is inexpensive,
- Has built in oscillators,
- Has a small instruction set to learn,
- Allows for wide range of interfaces including SPI, USB, USART, A/D, etc,
- Availability of processors in DIL package makes them easy to handle for hobby use.

The pin diagram and the block diagram of the PIC 18 microcontroller is as shown in the following figures,
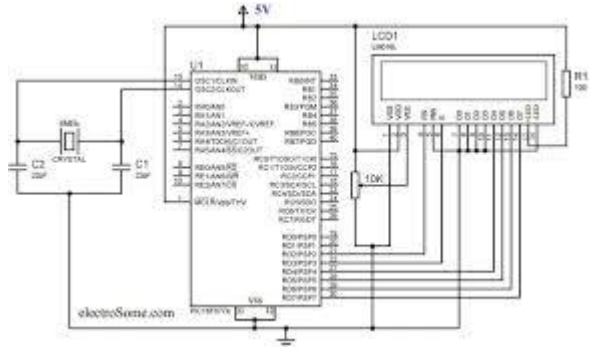

Figure 1: PIC Microcontroller

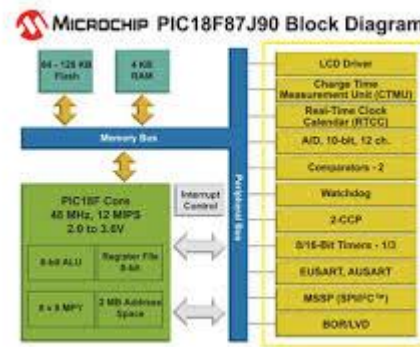Figure 2: Pin diagram of PIC 18 Microcontroller

Figure 3: Block diagram of PIC 18 Microcontroller

III.   WORKING

The following are the components and their use in our design:

- The accelerometer is used for fall detection. This device basically measures the deviation angle from the free fall direction. If the direction of the axis of the device is perpendicular to the ground, the deviation will be 0. Fall can be detected whenever there is a deviation measured.
- LM35 temperature sensor is used to measure the temperature of the user's body. This will be an analog input which will be converted into digital information using the ADC and further transferred to the doctor's system through GSM.
- Pulse counter is used to check for any deviation in the heart rate which is resulted from any abnormality in the body.
- LCD is used to display the text messages sent from the doctor. This can also be used to indicate the medicines prescribed by the doctor, any changes to be done in the dosages, alarm about the exercise timings, etc.

- There can be a BUZZER which can indicate the people around the user in case the patient is in a panicky situation.
- The GPS modem helps in locating the user on the map. If the user is in a trouble and is not in a condition to contact any family member, in such cases, on just one key press the pre stored message along with the location of the user is sent to one or more of her family members.
- The GSM modem is used to communicate with the dear ones over the network of their phones. Any messages to be sent by the user, in case of need, panic or any emergency can be sent over by using the GSM modem. This also aids in calling an ambulance in emergency situation.

IV.   APPLICATIONS

1. Periodic recording and transfer of the users information:
    As indicated by the block diagram, the device will include a pulse counter and a temperature sensor.
    These devices will measure the pulse rate and the temperature respectively, of the user. This information is then sent on to the doctor's system by employing the Tele-medicine concepts.

2. Reminder about the medications:
    The device will also have a LCD display, thus the doctor can transfer information, such as the medicines to be take, dosage of the medicines, time of consumption of that medicine, etc. This feature is of great importance when the patient has to be prescribed a different medicine after a certain amount of time. For example, during the first few months of pregnancy folic acid dosage is prescribed, later this medicine is changed to a different one.

3. Important messages from the doctor:
    Many a times it becomes urgent to inform the pregnant woman about the appointments with the doctor, and sometimes about the tests to be conducted. At such times the doctor can immediately send an SMS to the mother. Since it is a wearable device the message is always flashed on the on-board LCD screen and goes away only when the "Message Seen" Button is pressed.

4. Reminder about the exercises:
    During the Pregnancy the mother has to take care of her body so that she is fit and ready for the final day. Further the body generates a lot of aches and pains during the term of pregnancy. To ease all these pains the mother has to do a lot of yoga and stretching exercises which needs to reminded to be done at predefined timings. The system can be used to remind the same.

5. Indicating when the Pregnant woman needs to start moving to the hospital:
    As we all know, timing of labor pain is of great importance in indicating the proper time of delivery and is relied upon to a great extent in determining when the pregnant woman should start moving to the hospital and for how long the doctor may safely delay the delivery after arriving at the hospital . By accurately determining the frequency and duration of the labor pains the expectant mother can be prevented from admitting in a hospital too much in advance based on some false indications. The timing of these pains is also important in the labor room, for various reasons.
    The standard rule in the hospitals seems to be that, the expectant mother tells the nurse when she experiences a pain and the nurse makes a written note of the time of occurrence of the recurrent pains. In this manner the progressive shortening of the period between pains is ascertained. If the doctor is not present at the hospital at that time then he will be informed that the delivery is approaching and needs his attention. But, the nurse is not always at hand when the pain recurs and sometimes due to some disturbance, the pattern of frequency of the pains is interrupted and it may become insignificant to some extent. An experienced nurse can detect the periodic contraction of the uterus by placing her hand over the abdomen of the patient, but this method requires that the nurse be present by the side of the patient at all the times. Due to these difficulties we propose the use of the contraction timer calculator, which basically consist of a indicative scale with switches, that will act as a programmable stop watch and will need the patients input to note the time between the contractions and the intensity of the pain. Depending on this measurement, the device will indicate if it is the time to move on to the hospital.

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6. Any distress to be informed to the nearby people:

Any kind of breathlessness, heaviness in the stomach might also start cramps and might pose difficulty to call. In such cases a simple switch press might be able to start a Buzzer.

7. Automatic ambulance to be called in case of emergency:

In case of acute emergencies, the press of a button may enable the message or call to be made for requesting the service of ambulance at the present location of the user.

8. Automatic SMS to be sent with location in case of emergency:

Detection of a fall as will be defined later or on a press of a switch or the body temperature going above the normal or pulse count irregularities will all initiate an SOS SMS which can be used to call and alert an Ambulance. The SMS may also be sent to any of the family members of the user indicating that the user is in some sort of emergency.

9. Fall detection in case of a slip.

Any accidental slips of mother can cause major accidents, which may even lead to involuntarily termination of pregnancy; sometimes it can even be fatal for mother and the child. In such cases, using an Accelerometer, the tilt of the body can be detected which can indeed indicate the fall. Immediate attention may save the mother and the child from the dangers.

10. Mapping the location of the user on the map with relevant details.

The system will employ another GSM MODEM connected to the Google Map where the exact co-ordinates of the mother can be located. The information from the GPS will then be transferred in the NMEA format to the Base station (which might be at Home/ Police Station/ Hospital etc) (some predefined Numbers) so that the information can then be mapped on the Google Earth and the approximate location can directly be obtained on a real time Map. For this we will be using the Google Map API on which we will be able to plot the real time location of the user.

V. CONCLUSION:

The developed system helps a pregnant woman in communicating with her consulting doctor easily and effortlessly. Unnecessary cost of staying over at the hospital before the time that the delivery is due can be avoided. It may help us to prevent any adverse situations from occurring in the course of pregnancy.

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