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IoT Based Fetal Movement Counter with Fall Detector

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Abstract: Fetal movements are an important factor in the assessment of fetal health. However, there is currently no reliable way to monitor fetal movement outside the clinical environment. This work aims to design a non-invasive portable device for fetal monitoring movement which able to detect and record all the fetal movement in the womb starting from 28 up until 40 weeks of gestation. Furthermore, during gestation, pregnant women have a high tendency to fall and this factor will affect the fetal and mother's health. Falling during pregnancy will lead to severe injuries and negative pregnancy outcomes. This device uses a force-sensitive resistor (FSR) to count fetal movement, an ADXL335 accelerometer sensor to detect falls and an ESP32 as the microcontroller. When a pregnant woman feels fetal movement or kicking, they will touch the FSR sensor to record the beat counter. For fall detection, ADXL335 will detect whenever it senses unstable motions. Internet of Things (IoT) has also been implemented to this device using the Blynk application and they can monitor the readings using their mobile device. This portable device can help to trace and record fetal movement and detect falls. Pregnant women can use this dual-function portable device whenever they need and can help them to facilitate their fetal movement and fall detection performance.

Keywords: Fetal Movement, Pregnancy Fall, Internet Of Things (IoT)

1. Introduction

Perinatal death will decrease the maternal quality of life and cause the mother to experience acute grief. Fetal movement (FM) count known as a self-screening strategy may be useful to prevent perinatal death and improve pregnancy outcomes by increasing maternal awareness of decreased fetal activity [1]. Most women experience recognizable fetal movement by 28 weeks of gestation. Fetal movements felt by pregnant women are a sign that the fetus is growing. Their healthcare providers often teach pregnant women to monitor or be alert to their fetal movement [2]. A set amount of time will be used to start counting. Normally, pregnant women are advised to count at least 10 movements in 12 hours if it is needed more than usual for the movements to happen, it may be a sign of fetal compromise. Reduced fetal movement might be concerning for both the mother and the attending medical

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professional. Decreased fetal movement may be an indicator of potential fetal impairment or risk, requiring additional monitoring by the healthcare professional [3]. Plus, a pregnant woman has a high tendency to fall. This will lead to bad pregnancy outcomes such as miscarriage, loss of amniotic fluid or fetomaternal hemorrhage.

2. Materials and Methods

This work implements IoT to make it more relevant nowadays. A Wi-Fi connection is required to access the data from the Blynk app. Pregnant women can trace the record of fetal movement and fall detection from the Blynk app on their mobile devices. The FSR sensor helps to count the movement whenever the mother touches it. The same result is displayed on the OLED as well. The ADXL335 accelerometer detects and shows the result on Blynk when there is movement of the mother. Figure 1 shows the flow chart of the system. For an overall system, both FSR and ADXL335 sensors operate at the same time. The result for fetal movement can be seen on the OLED display as well as the Blynk app. It shows the beat counter reading for 10 kicks. For fetal detection, ADXL335 will detect the falls and the reading for axes x,y and z can be seen on the Blynk app. While Figure 2 shows the hardware setup for the system.

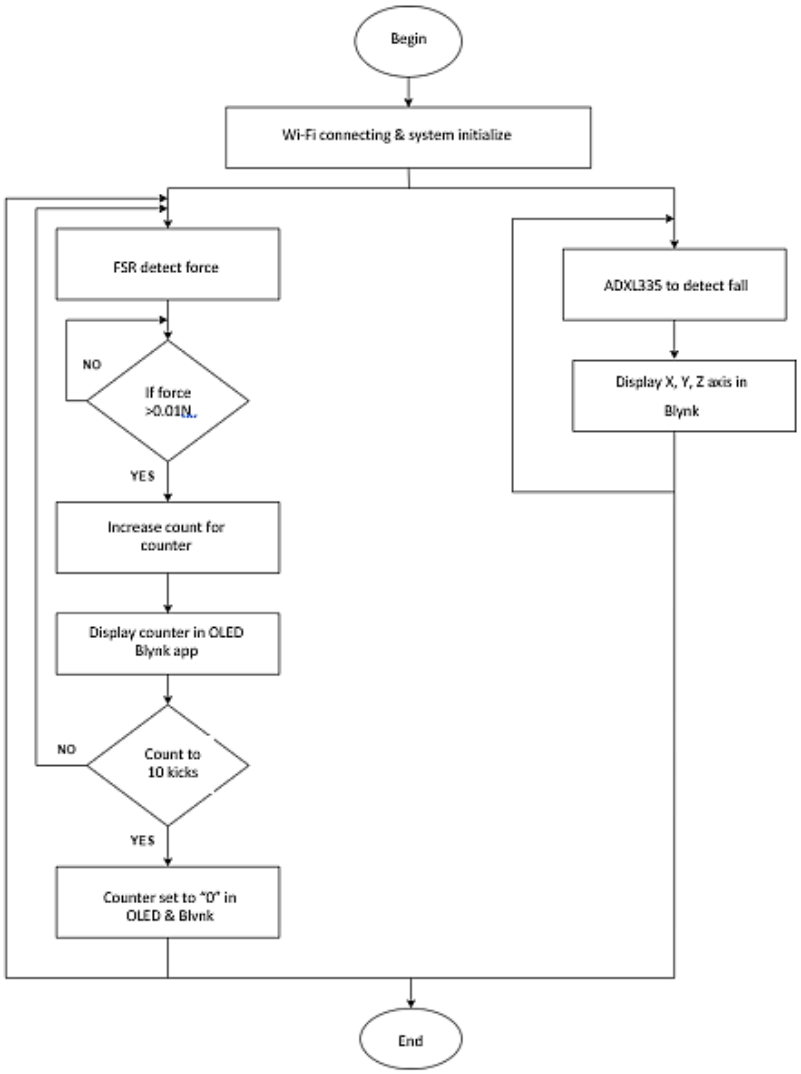

Figure 1: Flowchart of the system

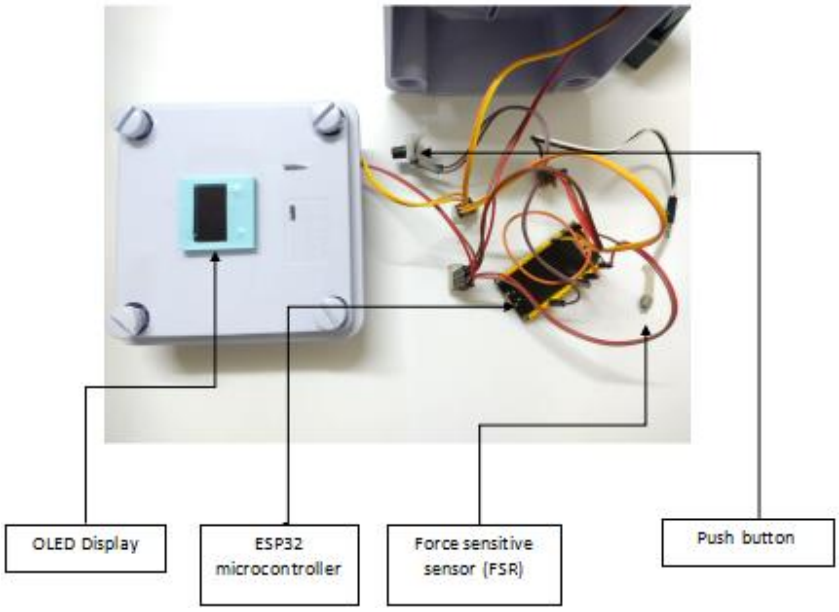

Figure 2: Hardware setup

3. Results and Discussion

Figure 3 shows the experimental result for the fetal movement counter. When the FSR sensor senses any movement from the mother when she touches their belly, it will start counting how many fetal movements the mother felt. The OLED display will show the result of the hardware connection.

Figure 3: Fetal movement experiment

Figure 4 shows the fetal movement counter result on the Blynk app. This result can be accessed on mobile devices such as smartphones and all the data of the fetal movement counter will be recorded.

Figure 4: Fetal movement counter result on the Blynk app

Fall detection is also being tested in Figure 5. In this experiment, the ADXL335 accelerometer recorded the readings for the x,y and z axis to detect falls during pregnancy.

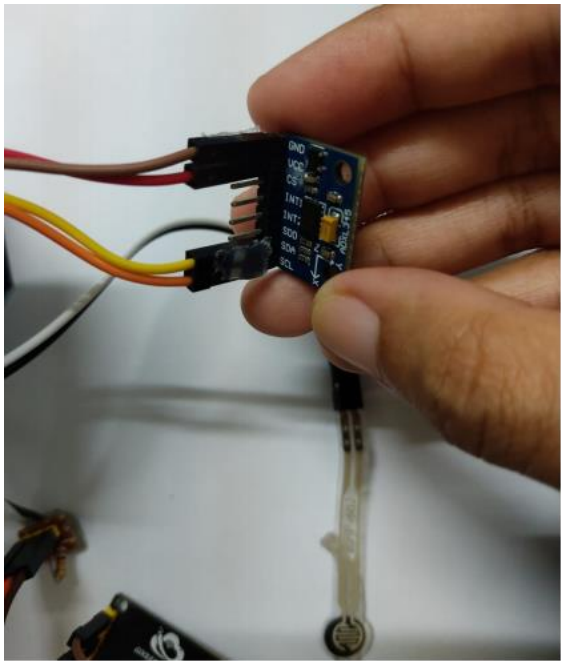

Figure 5: Fall detection experiment

Figure 6 shows the results for fall detection on the Blynk app. The results from the accelerometer show the readings from in x, y and z axes.

Figure 6: Fall detection experiment result on the Blynk app

The fetal movement counter is designed together with a fall detector to help pregnant woman monitor their pregnancy well-being. However, the FSR sensor has a very low sensitivity and accuracy towards fetal movement. This sensor is inconvenient and can be replaced with another highly sensitive and accurate sensor such as an audio sensor. ADXL335 accelerometer will show the result of x, y and z axes which the more movement detected, the higher the reading of the three axes. It will conclude as fall when the reading of all the axes is equal to 0.

3.5 Proposed design and placement of sensors

The proposed design of this portable device is small and compact. Both sensors and microcontroller are packed together in a portable case with a supply. A maternity belt can be used to secure the device and support a pregnant woman's abdomen to ensure stable measurements over time. Figure 7 below shows the proposed design and placement of sensors.

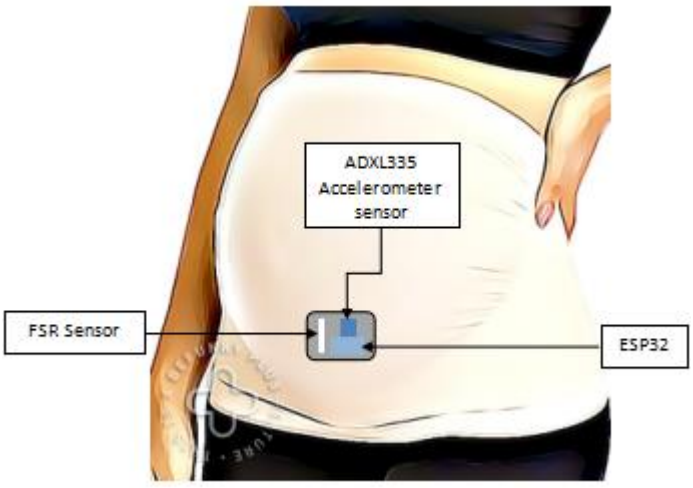

Figure 7: Proposed design and placement of sensors

4. Conclusion

Fetal movement is a very crucial aspect of pregnancy to ensure the baby's health. In this era, there are still some mothers who are not alert to monitor their fetal movement. Besides, pregnant women also have a high risk of falling during pregnancy due to body unbalanced. Falling during pregnancy will lead to severe injuries and negative pregnancy outcomes. This work aimed to design a fetal movement counter and fall detection in one portable device. The performance of fetal movement and fall detection can be analyzed using a mobile device. The mother needs to touch the FSR sensor whenever they feel any movement so the ESP32 microcontroller will transfer data to the Blynk app. The fall detection reading also can be accessed on the Blynk app as well. This device helps in developing tools to make their life easy by monitoring their fetal movement and body stability. In a nutshell, this work can meet all its objectives. Pregnant women can use this dual-function portable device whenever they need and can help them facilitate their fetal movement and fall detection performance. With the presence of IoT, this device will become more relevant to use in this era.

Acknowledgment

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