Design And Development of Baby Monitoring System Using Sensors

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Abstract- *In today's situation, parents are busy in their career. As we have seen in India that both the parents need to work and look after their babies/infants, so more workload and stress is there on such families especially on female counterparts. Therefore, the chance of providing better infant care is reduced. This may cause many troubles to the health of children. There is a danger of losing the life even, if the babies are not monitored properly and continuously. This proposed system presents a baby monitoring system for busy parents so that they can ensure the proper care and safety of their babies. For this, I use temperature, moisture, motion and sound detection sensors. So that the system can monitor the external conditions like increasing body temperature, crying of the baby when the voice exceeds the pre-determined range, movements of the baby, when found to be moving continuously and also indicates when cloth is needed to be changed, if excess wet was observed. The sensors will sense the things happening and microcontroller will operate the devices under the conditions the parents set for these devices The system is based on GSM network to send alert messages to the parents when any of these parameters exceeds the saved values. This system is attached with a video camera which is used to watch the baby from anywhere in the world. The video will be displayed on the screen of mobile or laptop to monitor the baby lively.*

Keywords- Microcontroller, GSM network, Video camera, Temperature, Moisture, Motion and Sound detection sensors.

I. INTRODUCTION

The old method for monitoring baby's vital signs requires direct supervision and attention from hospital staff or parents. Some of the times it is difficult to identify certain physiological changes which may be of concern. This health monitoring system provides real time indication of some of the changes in the infant's status. We can conveniently monitor the infant's situation in the hospital or at home while they go about their daily activities. Traditional monitoring techniques are difficult to wear for long periods of time and may cause discomfort to the infant. Sensors provide more convenient and long term monitoring.

The system will help the parents to take care of their child not only when they are at home but also when they are at the office or outside their home. This system will provide peace of mind to parents when they are away from their infant as they can obtain the updates of health of baby. Communication is done by GSM interface in which Short Messaging Service (SMS) is a fundamental part.

II. DESCRIPTION OF SYSTEM

This project presents a design of a Baby Monitoring System based on the GSM network. A prototype is developed which gives a reliable and efficient baby monitoring system that can play a vital role in providing better infant care. This system monitor vital parameters such as temperature, voice of baby, moisture condition, movement of an infant and using GSM network this information is transferred to their parents. Measurements of these vital parameters can be done and under risk situation conveyed to the parents with text message to initiate the proper control actions. The system architecture consist of sensors for monitoring vital parameters, any screen, Camera, GSM interface,LCD Display and AURDINO. The output display is corresponded to temperature and crying voice level and moisture level and motion data

III. OBJECTIVE OF PROJECT

The main aim of this project is to develop easiest way to watch baby and monitor his or her important parameters(temperature of body, crying sound,motion, moisture level) ,when there is no one near the child. The system is based on GSM network to send alert messages to the parents when any of these parameters exceeds the saved values. This system is attached with a video camera which is used to capture the video of the baby's movements. The video will be displayed on the screen to monitor the baby.
Main aim of our project: 1. Save the time 2. Provides maximum security 3. Provides safety.

IV. PROPOSED DESIGN

Basically, the proposed system is about monitoring the baby and its activities. This system will measure baby

movement activities, temperature of baby, moisture in the cloth by which baby is covered, cry activities of infant. The system consists of three sensors and a sound detection sensor. The sensors, the cry/sound detection sensor and the camera and LCD are connected to the arduino. The LCD has a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. On switching on the system, the LCD will show "Baby monitoring system" displayed on it. The sensor senses the conditions of the baby and gives that as input to microcontroller. The microcontroller compares the sensed data with the data stored. If any of the data is found to be abnormal then the microcontroller sends the information using GSM module to parents mobile numbers. Camera is also available to check the condition of baby lively. When message will come on mobile phone of parents, they can open the camera application on mobile phone to watch the activity of baby, whether the baby is crying or started moving. Camera gives SD/HD quality video of baby and it can also store the video in a memory storage.

The four sensors which I used in this model are temperature sensor, moisturesensor, sound sensor and motion sensor. I have previously stored values in program in arduino and when sensors will detect any change in that fixed values, GSM will send message on stored parents phone number. A LCD panel of 16x2 is also connected with Arduino ports. It acts as output device displaying the temperature, moisture, sound, motion value. This data is sent to it through Arduino pins.

Sound sensor will be associated with this project to detect the baby crying. This system will also consist of a PIR motion sensor to sense the baby's movement. PIR sensors are made of a pyroelectric sensor that can detect levels of infrared radiation. Everything emits some low-level radiation, and if the thing is hotter, it emits more radiation. The moisture can be measured using a soil moisture sensor which consists of two conducting probes that act as a probe. It can measure the moisture content in the diaper based on the change in resistance between the two conducting plates. The resistance between the two conducting plates varies in an inverse manner with the amount of moisture present.

Arduino microcontroller processes the digital signal to display the temperature sensor in Celsius ,digital humidity, motion value and sound value on the display. Any changes in the previously stored data in arduino is displayed on LCD along with sending message on phone number.

V. BLOCK DIAGRAM

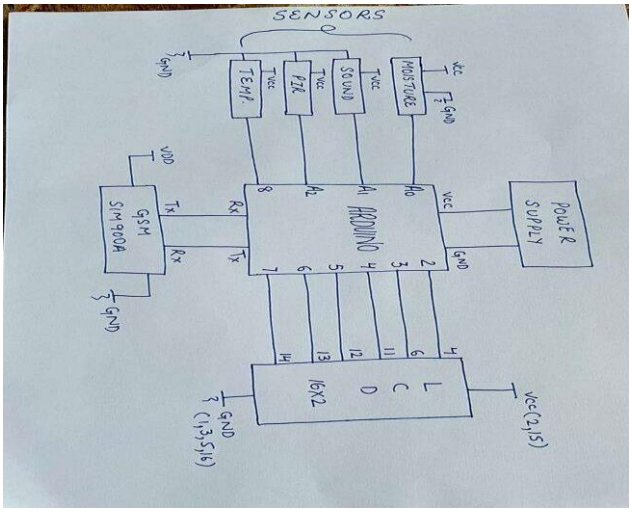

Figure 1.1 Block Diagram of scheme of the System

VI. HARDWARE FRAMEWORK

1) Arduino
2) LCD Display
3) Temperature sensor
4) Moisture sensor
5) PIR Motion sensor
6) Sound detection sensor
7) Voltage Regulator
8) AC Adapter 12V
9) GSM Module
10) Camera

6.1 Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to

support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

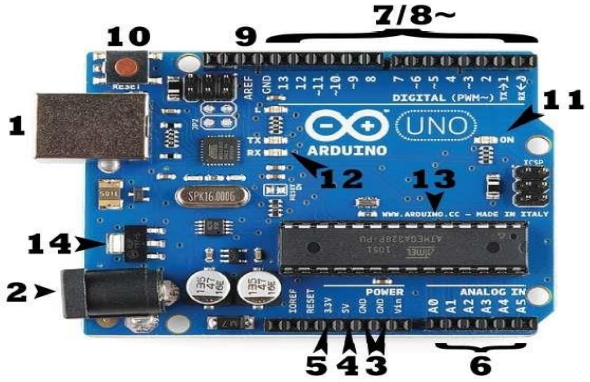

Figure 1.2: Arduino

6.2 LCD Display

In our prototype 16 X 2 LCD module is used. It has 2 rows and 16 column therefore total 32 characters are displayed. It has two operation modes, one uses all 8 pins and the other uses only 4 of them. The 4-bit mode was used to manage the LCD screen. All sensor output is displayed continuously as it is being measured. The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this 21 module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.[1]

Figure 1.3: LCD Display 16*2

6.3 Temperature sensor

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor. These sensors contain a chip that does analog to digital conversion and spit out a digital signal with the temperature and humidity. This makes them very easy to use with any microcontroller, including the Arduino.[2]

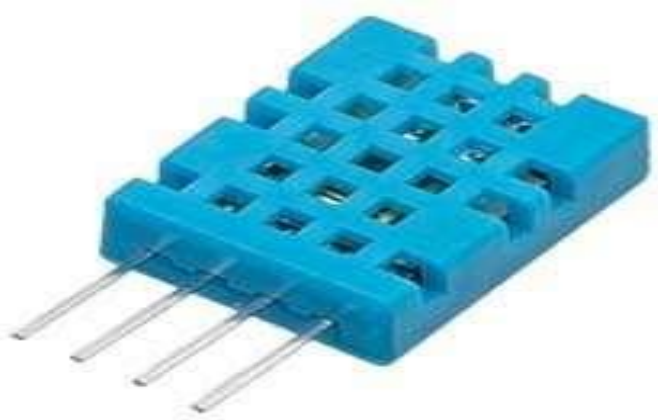

Figure 1.4: DHT 11 Temperature sensor

6.4 Moisture Sensor

The moisture sensor is one kind of sensor used to gauge the volumetric content of water within the system whose moisture you want to measure. The working of the moisture sensor is pretty straightforward. The fork-shaped probe with two exposed conductors, acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the system.

This resistance is inversely proportional to the moisture:

- The more water means better conductivity and will result in a lower resistance.
- The less water means poor conductivity and will result in a higher resistance.

The sensor produces an output voltage according to the resistance, which by measuring we can determine the moisture level.[3]

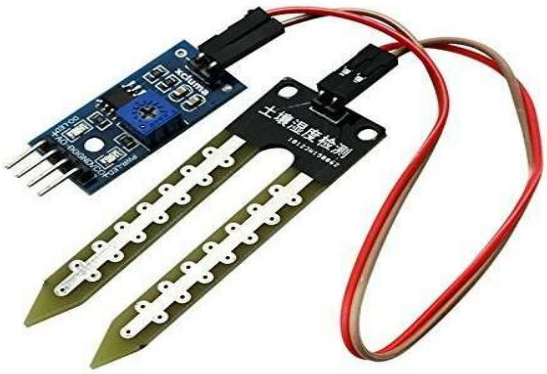

Figure 1.5: Moisture Sensor6.5 PIR Motion Sensor

A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects. PIR sensors mostly used in PIR-based motion detectors. Also, it used in security alarms and automatic lighting applications. The below image shows a typical pin configuration of the PIR sensor, which is quite simple to understand the pinouts. The PIR sensor consist of 3 pins, Pin1 corresponds to the drain terminal of the device, which connected to the positive supply 5V DC.

 Pin2 corresponds to the source terminal of the device, which connects to the ground terminal via a 100K or 47K resistor. The Pin2 is the output pin of the sensor.

 Pin3 of the sensor connected to the ground.[4]

Figure 1.6: PIR Motion Sensor

6.6 Sound Detection Sensor

The sound sensor is one type of module used to notice the sound. Generally, this module is used to detect the intensity of sound. The applications of this module mainly include switch, security, as well as monitoring. The accuracy of this sensor can be changed for the ease of usage.

This sensor employs a microphone to provide input to buffer, peak detector and an amplifier. This sensor notices a sound, & processes an o/p voltage signal to a microcontroller. After that, it executes required processing. This sensor is capable to determine noise levels within DB's or decibels at 3 kHz 6 kHz frequencies approximately wherever the human ear is sensitive. In smartphones, there is an android application namely decibel meter used to measure the sound level.[5]

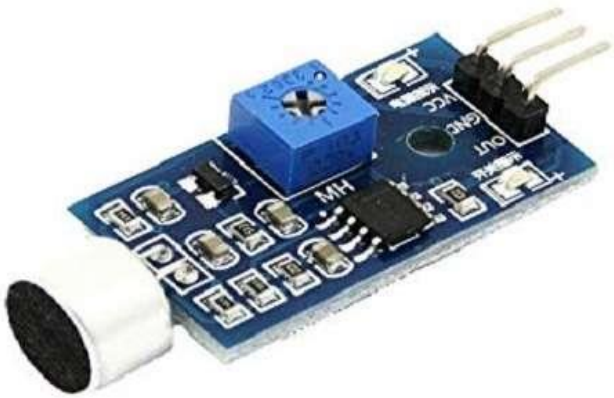

Figure 1.7: Sound Detection Sensor

6.7 Voltage Regulator

A **voltage regulator** is an electronic or electrical device that can sustain the voltage of power supply within suitable limits. The electrical equipment connected to the voltage source should bear the value of the voltage. The source voltage should be in a certain range which is acceptable for the connected pieces of equipment. This purpose is fulfilled by implementing a voltage regulator.

A voltage regulator – as the same suggests – regulates the voltage, regardless of the adjustments in the input voltage or connected load. It works as a shield for protective devices from damage. It can regulate both AC or DC voltages, depending on its design. The most common series of voltage regulators is the **78XX series**. The two digits after the 78 represent the output voltage of the regulator, for example the 7805 is a 5V regulator and the 7812 is a 12V regulator. The output voltages available with fixed regulators covers a large range from 3.3V to 24V with nice values like 5V, 6V, 9V, 15V and 18V available.[6]

Figure 1.8: Voltage Regulator

6.8 AC Adapter 12V

An AC adapter is a type of external power supply, often enclosed in a case similar to an AC plug. Adapters for battery-powered equipment may be described as chargers or rechargers (see also battery charger). AC adapters are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power.[7]

Figure 1.9: AC Adapter

6.9 GSM Module

GSM (Global System for Mobile communication) is a digital mobile telephony system. With the help of GSM module interfaced, we can send short text messages to the required authorities as per the application.

GSM module is provided by SIM uses the mobile service provider and send SMS to the respective authorities as per programmed. This technology enable the system a wireless system with no specified range limits. In this way, whenever the safe range of the vital parameter of an infant is violated, the programmed microcontroller produces an alarm and GSM Modem interfaced with the microcontroller sends an alert SMS to the parent's mobile number deploying wireless technology. The SIM900A is a readily available GSM/GPRS module.[8]

Figure 1.10: SIM900A GSM Module

6.10 Camera

A **camera** is an optical instrument used to capture an image. I have used Wi-Fi SmartNet Camera for my proposed model. Whenever parent will get indication alert message that one of the parameter got disturbed, for example temperature of baby got more than stored value, message will be sent to parents mobile and then they can switch to the camera app in the mobile and watch their baby lively and can decide about taking action.

This camera also has voice output. Parents can speak something in their mobile application to calm their child.[9]

VII. MODEL OF THE SYSTEM

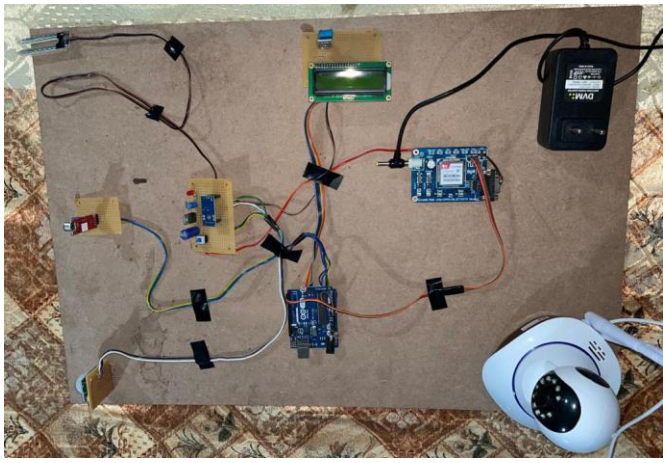

Figure 1.11: Top view of complete System

VIII. RESULTS

The system was tested carefully. During the execution of the system snapshots of the display were taken. The system being a complete hardware design and the data available on cell phone and LCD display have been captured. Test results of the system are given below, shows successful implementation of the system. For testing temperature sensor, I increased the temperature using matchstick. For testing motion sensor, I used doll as infant and moved the doll. For testing sound detection sensor, I played music on mobile phone. For testing moisture sensor, I used water.

Results are recorded and shown below in pictures:

Figure 1.12: LCD Display

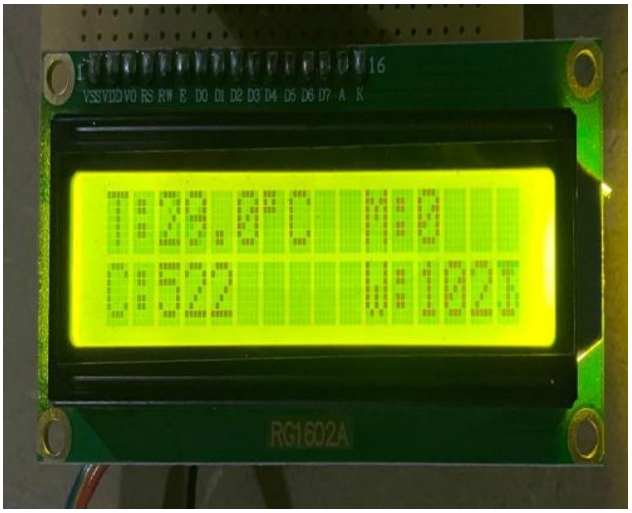

Figure 1.13: Initial values of parameters on Display

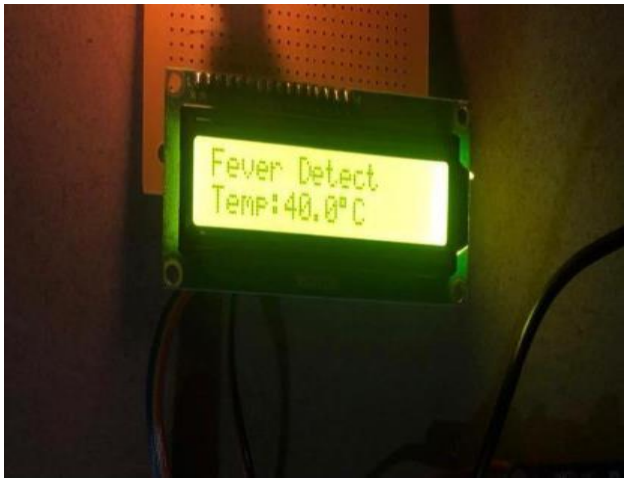

Figure 1.14: Changed temperature value displayed

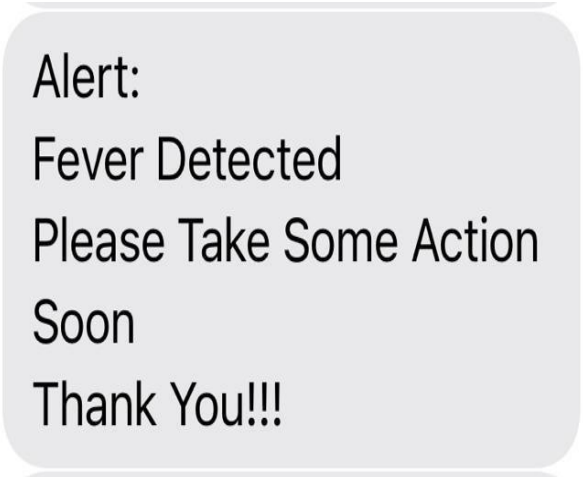

Figure 1.15: Message came to parent mobile

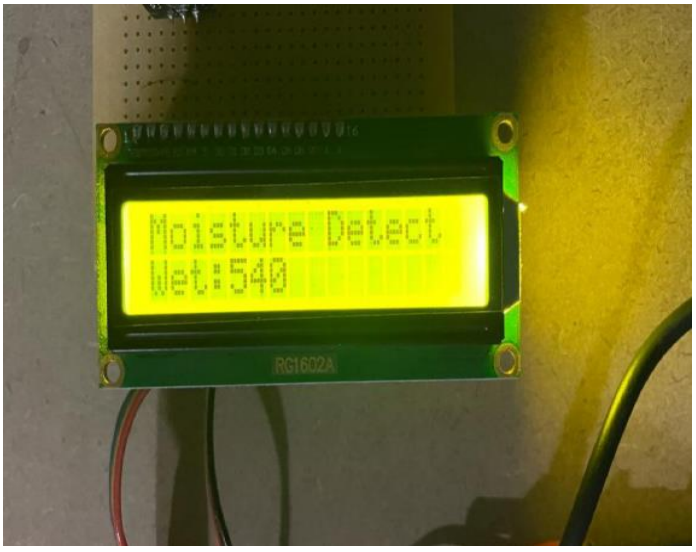

Figure 1.17: Changed moisture value displayed

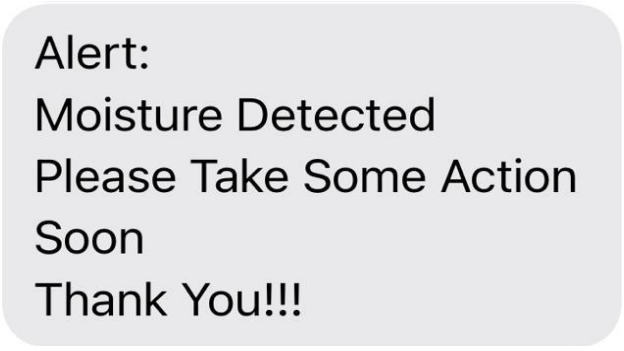

Figure 1.18: Message came to parent mobile

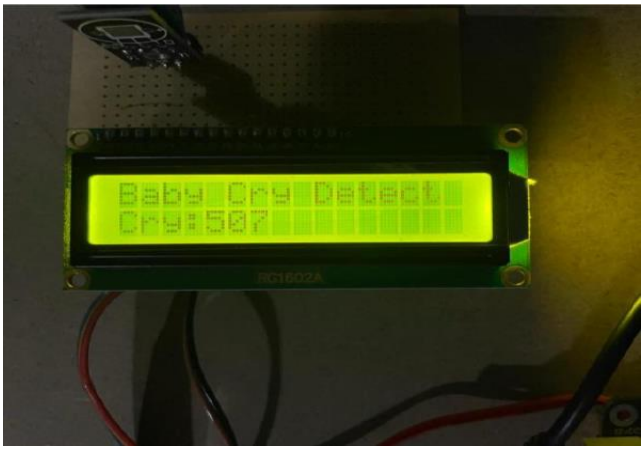

Figure 1.19: Changed sound value displayed

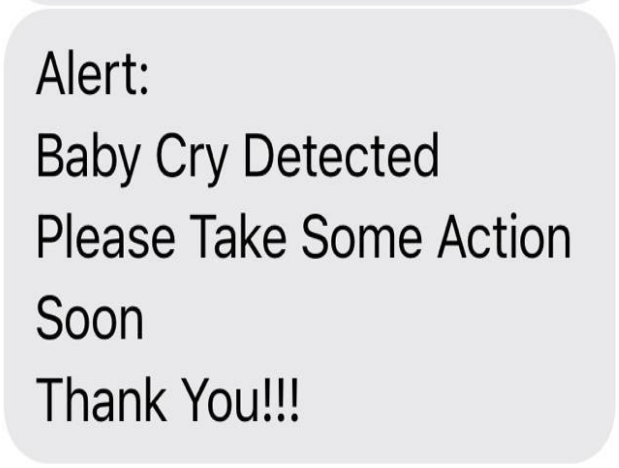

Figure 1.20: Message came to parent mobile

Figure 1.21: Changed motion value displayed

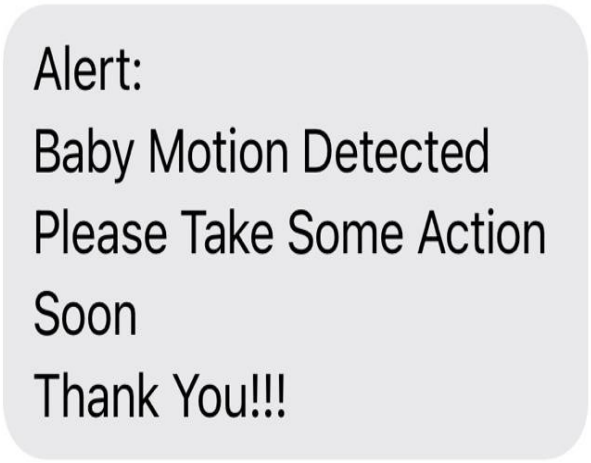

Figure 1.22: Message came to parent mobile

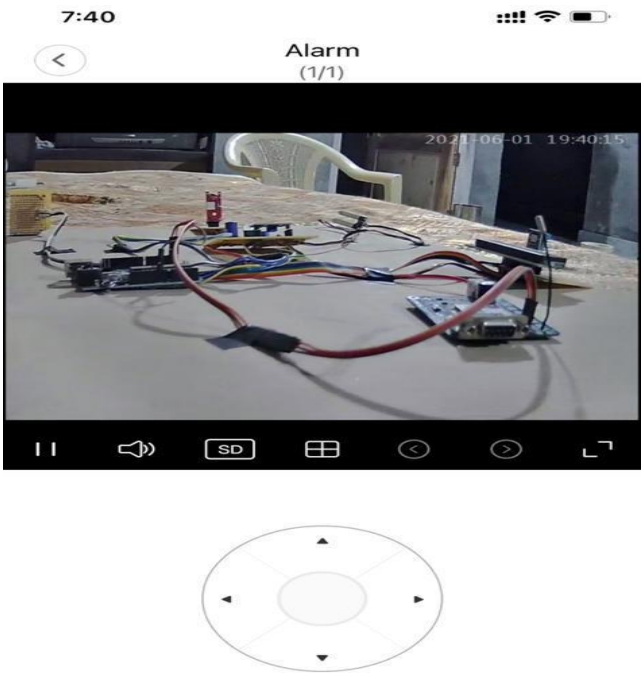

Figure 1.23: View from camera in mobile app

IX. ADVANTAGES

- It is an innovative, smart & protective system to nurture an infant in an efficient way.
- It saves time of the parents.
- Immediate message is sent to parents if any problem occurs.
- Parents can also watch their child on mobile screen.
- Cost of the system is low as compared to the value of the important time of the parents.
- This system can be employed in hospitals, crèches and homes.

X. CONCLUSION

The design model is easy to implement and very customizable according to the user requirement. The integration of various sensors with arduino will provide a better way for the monitoring of the baby. The concept of camera itself helps in monitoring of babies lively. Proposed Baby Monitoring System is an inexpensive and simple to use, which can improve the quality of infant-parent communication. It is just an approach of taking the advantages of modern technology which has no effect on daily activities of the parents. This system expressively provides the parents with the feeling of assurance. Effective use of this system can remove the anxiety and monotony of the parents. It might be used in hospitals by the nurses to monitor the baby. The constant capturing of multiple biological parameters of the baby and analysis of the overall health helps mother to understand the internal status of the baby. As GSM technology is used which makes the users to communicate for longer distances. This is a convenient system to monitor the baby's health condition from any distance.

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