

A real time monitoring system with oral feeding for premature infants

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Abstract

With the advancement of the medical industry the death rates of the premature newborn infants have been brought under control. Even after the advancements in technology, there is a need for instrument health care interactions due to varied reasons. This approach discusses about the development of wireless transmission of oral feeding disorder with the help of flow sensor, sound sensor and EMG sensor for the early intervention of the any oral feeding difficulties in the child. The flow sensor is used for sucking and sound sensor is used to detect the swallowing sound and EMG sensor is used to record the muscular activities of the premature infants. And then, the temperature sensor, BP sensor and heart beat sensor will display the values of the premature infants through LCD. In sensing unit, ARM7 (LPC2148) microcontroller is used to program and work the circuit. In software requirements, Keil compiler and embedded C language is used. Zigbee is used for wireless communication and this will act as a transceiver and the final values will be displayed by lab VIEW software through PC. So Finally, This system has designed for a real time monitoring system with oral feeding for the preterm infants.

Keywords: Preterm Infants; Lab View; Zigbee; Heart Beat Sensor; Sound Sensor.

1. Introduction

Nowadays, technology is moving advance in all possible ways, particularly in the area of care products and health where the needs are helping for life Arvdeson. J et.al, (2010). Extra production is acquire when it move to children or babies. Particularly in case of babies in low weight (less than 1Kilo Gram) and premature babies or child, who wouldn't have created the mechanism of thermo regulatory the safety measure is doubled, Bor-Shyh Lin, et. Al, (2013). Usually preterm infants are not capable to get total oral feeding position in the weeks of early postnatal. Major difficulty that preterm infants meet problem related the oral feeding for swallowing reflexes and sucking Cleveland. K, (2010). Coordination between sucking and synchrony, breathing, and swallowing is necessary for safe, smooth, and efficient oral feeding Arvdeson. J et.al, (2010). Unhappily this synchrony not creates in preterm babies until 32-34 this period age Bor-Shyh Lin, et. Al, (2013). The coordination result lack in improved feeding-connected try which simply tedious babies during feeding, important to decrease in milk drinking, underfeeding, and development and expansion issue. To overcome this issue we proposed oral feeding wireless transmission disease with sensor. In existing system of wireless oral feeding watching system, Lau. C, (2003) for preterm babies to measurably monitor the pressure of sucking by developed sensing device of sucking pressure, swallowing action by microphone to identify sound of swallowing, and breathing movement of diaphragmatic by surface electromyogram.

2. Materials & methods

Furthermore, swallowing-sucking-breathing identification algorithm is suggested to estimate the action of swallowing-sucking-

breathing behavior. This paper suggested six sensors, these are, sound sensor- it used to sense in babies mouth action to identify the sound(cry), that time voice signal sense transmitted, EMG sensor – monitoring all muscular behavior of babies by transmits and sense signal, Flow sensor-it sense the feeding values and ability and send all calculated values and signals, Temperature sensor – it used to calculate baby and room temperature signals, Blood sensor – describe infant blood pressure whether it is normal or abnormal, Heartbeat sensor – it describe heart beat values.

All sensor are embed with hardware components Cleveland. K, (2010). It is like a circuit port attached with Zigbee modem. The main hardware components is stepper motor amplitude. The stepper motor is worked related on six values of sensor signal, All sensor activity is send to stepper motor by zigbee components. The signal activities are calculated using lab view McGuire, et. Al, (2004). It used to identify the which signal is currently processing, then read that value of signal process and send to stepper motor to automatic run to help babies.

A new electrode non-contact circuit and has applied for the development of electrocardiogram for monitoring system of mobile, Arvdeson. J et.al, (2010). The proposed electrode of the non-contact could measure bio-potential clothing across over embedded user for normal monitor of ECG in user's everyday schedule. They also try to simplify and modify the design for reducing the consumption of power for providing a better quality signal. The electrical condition and monitoring performance of arrhythmia in medical setting were validating to examine the proposed design reliability. Experimental outcome explain that the suggested non-contact electrode gives better quality signal for determining ECG signal across skinny clothes Renfrew. M, et. Al, (2009).

To perform evidence related systematic evaluation and gives an estimate of oral motor intervention effects on swallowing feeding outcomes and health of preterm babies, Bor-Shyh Lin, et. Al, (2013). There are no studies or reports have been produced over

the health pulmonary. The quality will be varying greatly over the methodological health monitoring system. A (Diaphragm Electromyography) dEMG transcutaneous is easy and noninvasive tools for measuring the diaphragm electrical activity. The dEMG monitoring system is introducing the neonatal ICU (Intensive Care Unit) for monitoring novel cardio respiratory for providing the information for direct breathing diaphragmatic activity Cleveland, K, (2010). The report of infant's are suspecting the right diaphragm paresis measurement over dEMG transcutaneous that is showing the sharp reduction on the activity of electrical phase in right side diaphragm. The dEMG is providing the important information over the activity of regional diaphragmatic. A research over the monitoring system of wireless feeding for infants to develop for sucking monitoring system. The breathing-sucking-swallowing function is continuous and noninvasively. The proposed algorithm is allowing the detection of breathing-sucking-swallowing that successfully developed the detection of sucking-swallowing-breathing activities Herrmann, K, (2012).

3. Proposed system

3.1. Overview

Oral feeding disorder is common in premature infants. Oral-feeding disorder becomes one of the important indicators of high-risk group for neurodevelopment delay in preterm infants. Preterm infants must coordinate the motor patterns of sucking, swallowing, and breathing skillfully, which ensure milk flowing into the oral cavity effectively, triggering swallowing reflex and completing ventilation Tamilia, E, (2015). Recently, the ability of oral feeding in the infants has been investigated by some neonatal oral feeding studies. The overall architecture of the system shown in the Fig. 1.

3.2. Sound sensor

The sound sensor is used to sense the sound signals. After sensing the sound signal it sends to Zigbee. Based on the sound signal the stepper motor will do process automatically.

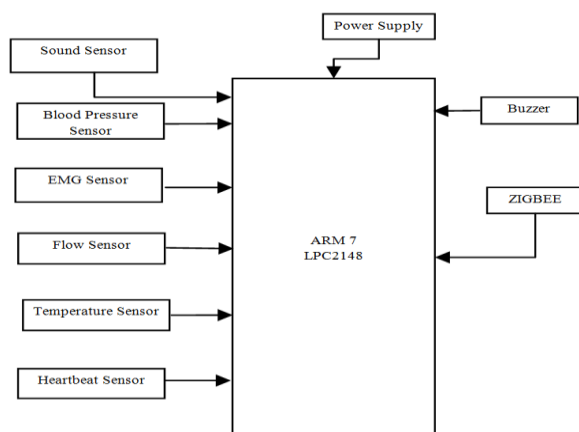


Fig. 1: Overall Architecture.

3.3. Flow sensor

Flow sensor is used to sense the infant activity, feeding time and limit and generate various pressures across sensor. The flexible tubing transmits various pressure signals to sensitive pressure sensor beside the monitor. Flow sensor contains gas molecular weight, airway pressure, temperature and factors influence flow measurement.

3.4. Temperature sensor

The temperature sensor is used to sustain infant in thermo neutral ecological zone. LM35 are integrated-circuit which output voltage

linearly relative to Celsius temperature. LM35 has more advantage than the linear temperature sensors standardized in Kelvin. To achieve suitable Centigrade scaling user doesn't need to subtract constant voltage from output. Physiological zone described as narrow range ecological temperatures which infant sustains average body temperature not increasing infant oxygen consumption and metabolic rate. Although infrared thermograph, skin electrode consider reliable and effortless tool to mapping and measuring temperature distribution of human skin and support in assess thermoregulatory reflexes.

3.5. Blood pressure sensor

Blood pressure rises with postnatal age, birth weight, gestation. Blood pressure can be exaggerated by gender particularly in life. In normal infants there is not significant dissimilarity between calf and arm blood pressure. In the ELBW infants normal BP value of infant difficult to describe. In clinical observe, infant blood pressure normally considered to adequate capillary refill and urine output within average limits. In general no metabolic acidosis is there. Normally, 72 hours age of infants should have more than 30 mm Hg blood pressure. Hypertension arbitrary follows infant should have greater than 60 mmHg diastolic and greater than 90 mmHg systolic and preterm infant have greater than 80 mmHg systolic and above 50 mmHg diastolic. The value of blood pressures sense and send to zigbee.

3.6. Heartbeat sensor

The heartbeat sensor is used to detect heart beat by determining blood pressure. Every 5sec the heartbeat sensor compute average value and display. This process continues to twelve times. The heartbeat value display in the LCD If the heartbeat rate exceeds normal level the message will send to the LCD which display heartbeat rate.

3.7. Amplitude stepper motor

Stepper motor is also called as DC motor. Stepper motor has multiple coils that categorized groups as "phases". Based on the sensor signals motor rotates one step by every phase Renfrew, M, et. al (2009). We can accomplish speed control and precise positioning. Stepper motors come up to many various sizes and electrical characteristics and styles.

3.8. Zigbee modem

Zigbee is high level protocol technology and it using low power digital radios. When compare to WPAN zigbee is less expensive like Bluetooth. For intermittent data or periodic or input signal or sensor signal 250 kbps rate is used. ZigBee Modem offers wider radius for same cost by reducing effective cost construction. Zigbee has more advantage than Bluetooth. Zigbee communicate between Incubator and PC wirelessly.

4. Result and discussion

This work is based on a real time monitoring system with oral feeding of premature infants which monitors the sucking pressure, swallowing activities and muscular activities of premature infants. The complete circuitry alongwith baby is shown in the Fig. 2.



Fig. 2: Complete Circuitry with Baby.

The sensors output values are displayed on LCD. Microcontroller is used for programming and working of the circuit. Then the zigbee is acting as a transceiver and values are displayed on a PC by using labview. Then its been implemented for adult by using labview. And, in this analysis have detected the sucking activities for one rotation is 56.00 m³/sec. Then, the heart rate have been detected and the predictive value is 70 beats/min. The EMG value have detected is 14.67/mv. And the temperature value will be in Celsius. The labview output is shown in the Fig. 3.

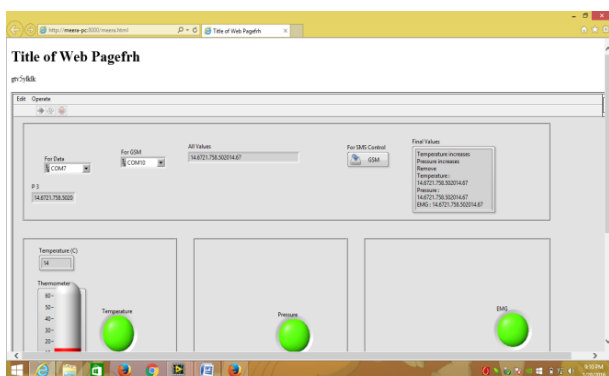


Fig. 3: Labview Output.

The above discussed techniques are providing better result for breastfeeding for the newborn infants and the infant during oral feeding is shown in the Fig. 4.

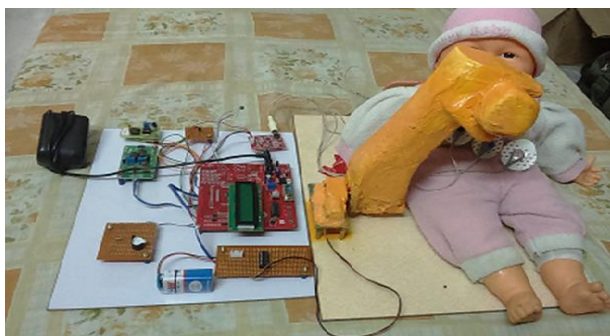


Fig. 4: Infant During Oral Feeding.

The sensors process and oral feeding efficiency is high in compare to the existing system. The Fig. 5 is presenting the existing and proposed system time consumption for the process of sucking-breathing-swallowing. The simulated figure is presenting the better performance of the proposed system.

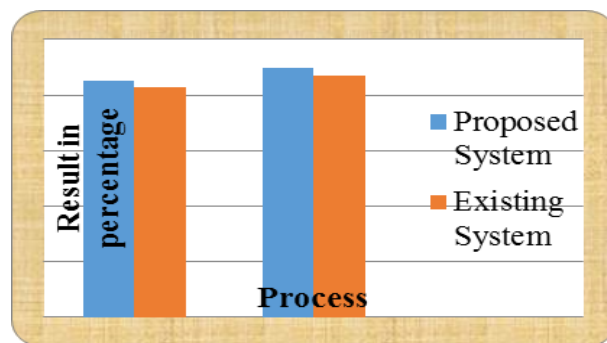


Fig. 5: Accuracy Performance.

5. Conclusion

This paper proposed swallowing algorithm to oral feeding to the infant by using sound sensor, EMG sensor, flow sensor, temperature sensor, heartbeat sensor and blood pressure sensor. These sensors are fixed in the zigbee. Based on sensor signals stepper motor automatically works. The sensor output will display on the LCD. When compare existing technique its gives more accurate result. The measurements are acceptably accurate. And it can be used to monitor all parameters and the pressure variations. This approach conclude that automatic oral feeding monitoring system is better than that of the manual ways of oral feeding for premature infants.

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