

Design and Fabrication of Automatic Baby Cradle System

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Abstract - Cradle is an appliance which use to carry a baby and oscillate automatically with certain speed for comfort sleep of a baby. Babies sleeps sound in mosses baskets or cradle, as they afford a limited sleeping atmosphere which helps them feel secure. B-Care is a novel concept, which enables the movements of a carriage, to raise the cradle, to move the machine from one place to another, automatic movement of cradle when baby is disturbed and much more. The equipment Baby care includes a dc motor, link, and an oscillating bed and sensors. The electric powered motor will actuate the links by shaft. Links actuates the rod attached to the bed at constant speed. The carriage is attached to the metal rod through springs which will provide a vibratory motion. It will also ensure the cradle motion even when the baby cries or moves using sensors. Motor, link and sensors are attached to the side of the cradle frame. High strength, light weight material is used for the manufacturing of Baby care. Baby care is the most cost effective, user friendly, automated mechanism for baby care in the modern nuclear family.

Key Words: Mobility Aid, Baby Care, Motor, Cradle, Carriage.

1. INTRODUCTION

In today's world, everyone is busy in its own life. Nowadays, even the mothers are working and there is a requirement of unattended cradle. The proposed E-Cradle is a novel solution to this problem. In the proposed design, there will be a circuit placed along the cradle which will sense the sound intensity of the cry of the child and takes necessary actions based on the sound intensity of the child's cry.

The system is designed to help parents and nurses in infants care. The design aims at following points:

- Cradle starts swinging automatically when baby cry.
- If the baby stops crying before 2 minutes, then the cradle will stop automatically after 3 minutes of swinging.
- Sounds an alarm if baby cries for more than a stipulated time of 2 minutes indicating that baby needs attention.
- Sounds an alarm when mattress gets wet.

Before the use of cradle in society, baby caring was completely by caretaker but in the nuclear family baby

caring is very difficult. So there is a need for automation in the cradle section. As the baby needs more care and safety automation of cradle is very much difficult for safe design. Cost is much important to develop a cradle with an automated mechanism. The family faces the problem of carrying the baby to places for that cradle must be mobile. So the standard living of the reputed family needs the automated cradle. Various small industries uses components made of plastic, rubber etc., assembled mechanically to make simple cradle but when using automation we need material with strength and for simple using materials must be weightless. For considering safety of baby sharp edges are covered with rubber. Cradle performance and efficiency is high as it needs less electricity and probability of failure is completely removed.

Since safety is necessary for baby, care has to be taken during production and assembly of its component parts. Many tools and equipment used in the domestic as well as small scale industries are designed to help the personnel working in production facility. Special instruction books are given to help the care taker for easiness. Our project aims at the design and fabrication of an Electro Mechanical Cradle for the purpose of using it in nuclear family with medium income. The principle used here is that cam which will rotate according to the mechanical power given to it, in our project the carriage is being oscillated with the help of a U-frame which is coupled to a cam which is mechanically powered by motor (low speed high torque motor). Also this device is likely to be used in public places where the family goes.

There are a lot of limitations encountered in the use of conventional cradle. Conventional cradle is not user friendly, has less comfort, more time consuming, and is less safe. The idea of automatic cradle which will overcome the above stated limitations. The design and construction of an automatic cradle ensures comfortable and safe sleep for the baby. It may be used without a necessary external assistance or assistance from a care taker due to the concept of the design. The project is aimed at designing and constructing an electrically powered mechanical cradle for rocking a baby in a carriage with ease and in the most economical way. The cradle is expected to work with minimal technical challenges and greater comfort due to its wide range of application. The device can be used in any height within a range and can be moved from one place to another by castors attached to the frame. This project has a great relevance in the modern nuclear family.

2. LITERATURE REVIEW

Steven Bang designed automatic baby rocker having a noise sensor to detect baby cry. Noise sensor consists of Electret MIC with a pre amplifier (2n3904 transistor). Signal from noise sensor is fed to microcontroller Arduino ATmega 328, which is used to control the DC motor. Few colorful lights made up of LED are used to entertain the baby while being rocked. Mabuchi RE-260RA DC motor with Tamiya 6 speed gear box is used to create the rocking motion of the crib with gear ratio of 505.9:1.

Yang Hu proposed an algorithm for adjusting the bassinet swaying extent by the sensor signals. The bassinet is made up of an adaptive swaying device and other sensors network. While baby is crying, the sensors network can judge the reason according to detecting parameters, giving the different signals to control circuit. At the same time, the bassinet starts to sway slightly. The swaying rhythm can be adjusted according to parameters from baby status. They used three pressure sensor located in the bassinet bottom, one at the centre and others at left and right of the bottom.

Marie R. Harper invented a crib adapted to be rocked automatically. Once the crib is manually tilted in one direction and released, this permits the inertia to actuate the locking and actuating arms to operate under the biasing force of spring in conjunction with the gear. Thus spring loaded motor begin to operate and the lever arm is oscillated in back and forth movement. This provides the same effect as would be achieved by the mother rocking the crib containing the baby. Oscillation of crib is stopped when the slightest resistance is incurred.

Gim Wong presented an Electronic device that can be attached to conventional pivotally mounted type crib. Which is actuated by baby cry voice picked up by the microphone giving short throw type rocking action to crib. Very similar to a person rocking the crib by pushing and pulling on the foot or headboard. There is a sensitivity control so that baby voice only actuate the rocking action and a timer to control the duration of rocking action.

Chau-Kai-Hsieh proposed a baby cry recognizer which includes an amplifier circuit for amplifying a received sound signal. In response to the amplified sound signal, a pulse generator circuit generates a pulse signal having zero crossings which are aligned with zero crossings of the amplified sound signal. The pulse signal, in turn, is inputted to a signal recognition circuit. The signal recognition circuit outputs a signal indicating that a baby's cry was detected.

Anritha Ebenezer gives an approach to design a baby cradle consisting of cry analyzing system which detects baby cry. According to sound intensity cradle swings. It has six rocks per minute. It has wet sensor to indicates baby wets, whenever baby wets resistance would change thus sending a signal. Other sensors include temperature sensor to display

baby temperature, respiratory sensor that sends a signal in apnea condition. GSM modem via RS232 is used to send msg to parents in case baby does not stop crying with in a particular instant of time.

3. DESIGN AND SPECIFICATIONS

The figure 1 and 2 shows the details of the analysis done on the lower frame of baby cradle. The standard mesh used consists of 11594 elements and 4389 nodes. Uniformly distributed load of 20 kgf is applied at the base of the carriage, taking factor of safety as 2.

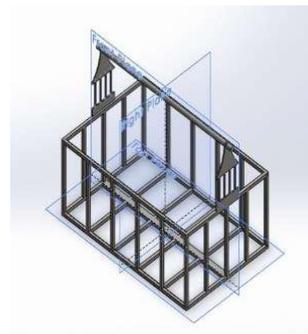


Fig-1: Frame Design

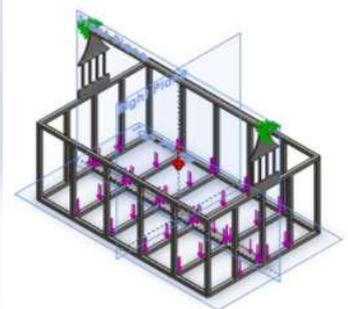


Fig-2: Frame Analysis

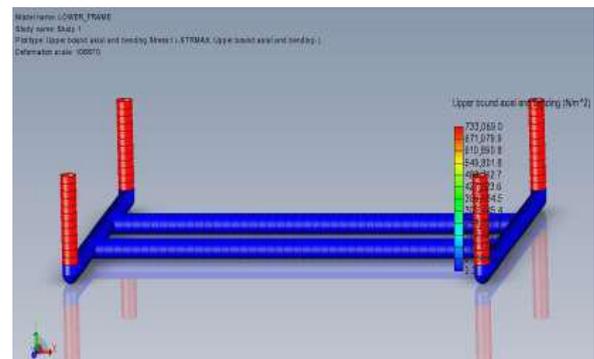


Fig-3: Lower Frame Stress Analysis

The figure 3 shows the equivalent static axial and bending stress for the lower frame. The stress effect will be maximum at the four legs of the frame.

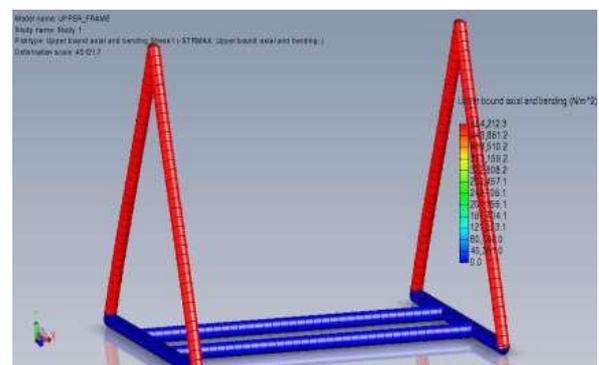


Fig-4: Upper Frame Stress Analysis

The figure 4 shows the equivalent axial and bending stress for the upper frame. The stress effect will be maximum at the triangular section.

4. EQUIPMENT DESCRIPTION

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule. When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.



Fig-5: DC Motor

Figure 5 shows the DC motor used as wiper motor in automobile field. A 12 V, 17 W DC motor is used in the fabrication of the cradle.

Battery: In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photovoltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties like Low cost, Long life, High reliability, High overall efficiency, Low discharge, Minimum maintenance.

Bearing: A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In cradle, one race is stationary frame and the other is attached to the rotating shaft to which carriage is attached. As one of the bearing races rotates, it causes the balls to rotate as well because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each

other. Ball bearings tend to have lower load capacity for their size than other kinds of rollin-element bearings due to smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

Carriage: Carriage is the portion of the cradle which swings when it is driven by the motor through links. This consists of springs which gives comfort for baby when it moves. The carriage used in our project is 30 × 20 × 12 (length × breadth × height) inches in dimension.

Motion Sensor: A motion sensor is a device that detects moving objects, particularly people. A motion detector is often integrated as a component of a system that automatically performs a task or alerts a user of motion in an area. However, a passive sensor only senses the signal emitted by the moving object itself. Changes in the optical, microwave, or acoustic field in the device's proximity are interpreted by the electronics based on one of the technologies listed below. Most inexpensive motion detectors can detect up to distances of at least 15 feet (5 meters). Specialized systems are more expensive but have much longer ranges. Tomographic motion detection systems can cover much larger areas because the radio waves are at frequencies which penetrate most walls and obstructions, and are detected in multiple locations, not just at the location of the transmitter.

Sound Sensor: Sound sensor is a device used to detect the intensity of sound. In this study we analyse the sound of baby. For a male child the sound intensity is 31-33db and for a female child the intensity level is 30-32db. A sound sensor of 70 db is used in this project which is shown in figure 6.

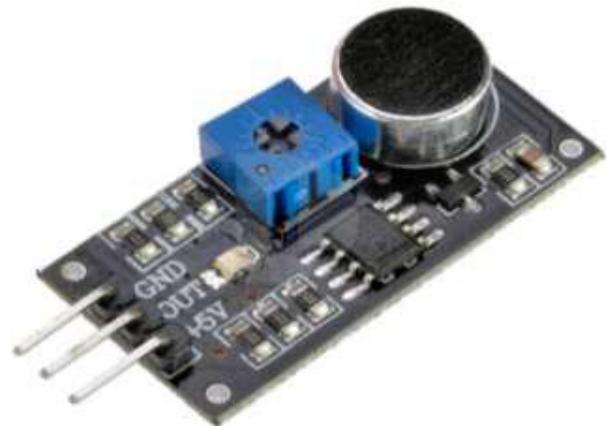


Fig-6: Sound Sensor

Arduino Uno: Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. One can tell the board what to do by sending a set of instructions to the microcontroller on the

board. To do so people use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments.



Fig-7: Arduino Microcontroller

A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide. This prototype uses an Arduino UNO board for programming as shown in figure 7.

5. CONCLUSIONS

The present work reduces the human effort and particularly mother's stresses in working times. The equipment Baby care includes a motor, sensors, and oscillating carriage. The overall mechanism is mobile which allows easy movement from room to room. The electric powered motor will actuate the links by shaft and the links actuates the bed in a constant speed which is attached to the carriage. The main advantage of this device is its low initial cost, and has allowed operating cost. The device affords plenty of scope for modifications for further improvements and operational efficiency, which should make it commercially available and attractive.

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