

Development of an intelligent baby cradle for home and hospital use

A thesis submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF TECHNOLOGY

IN

BIOMEDICAL ENGINEERING

By

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CERTIFICATE

This is to certify that the thesis entitled “**Development of an intelligent baby cradle for home and hospital use**” submitted by **Aquib Nawaz (111BM0010)** in the partial fulfillment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering at National Institute of Technology, Rourkela is an authentic work carried out by them under my supervision and guidance. To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

Date:

Place:

Prof. Kunal Pal

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ABSTRACT

The customary Automatic child cradle frameworks are excessively lavish and they additionally don't offer much usefulness. This venture intends to help those moms who are excessively occupied and don't have a cleaning specialist or sitter to deal with their infants. This paper portrays the configuration of a programmed cradle which fundamentally chips away at location of infant development with the assistance of a PIR sensor. PIR sensor detects the movement of infant. After the location of enlivening of infant various occasions are terminated which incorporate sending notices to mother by SMS, swinging of cradle with the goal that the child feels good. In the event that the child does not rest and/or quiets down after a certain period, a warning (SMS) is sent to the folks saying that the infant needs their consideration. The cradle likewise incorporates extra gimmicks like observing the temperature of the infant to give therapeutic thoughtfulness regarding the child and cautions the folks if the body temperature of the child goes above to given threshold temperature. The cradle additionally incorporates a wet sensor which will caution the folks or the attendant/sitter for bunk wetting of the infant. It will help to keep the infant in a hygienic environment. The framework is kept negligible as far as fittings as greatest measure of usefulness of the cradle is performed through Arduino. The cradle is vitality productive and obliges no physical consideration.

Keywords: Automatic cradle, bed-wet sensor, PIR sensor, swinging of cradle, movement detection

CHAPTER-1 INTRODUCTION

(1). Introduction

Generally, the baby cradle is used for to make sleep and soothe to baby. For example guardian have to take care of their child till as they asleep. However, conventional cradle does not electronically equipped such like battery or adapter to automate the cradle automatically. In Addition to that, these kind of conventional cradle is used in villages areas or non-developed cities due to its low prices. But the problem of this kind of designated cradle is that you need manpower to take care of your child and your child may not be safe and feel comfortable in the conventional cradle. Thus, we need automatic cradle to take care of child which uses the battery or power source.

Besides, there are extra features or function is provided by the newly automatic cradle that is beneficial for parents. Because in the present world people are very busy in their professional life so they do not get ample time to take care of their infants. It will be very difficult control the babies and if someone is hiring professional to take care of their infants. It may increase your expenses from monthly expenditure. Moreover, in today, life it is very hard to even for the homemakers (mummy) to sit nearby their babies and sooth them whenever they feel uncomfortable. Though, it is automatic this application is very useful for the nurses in maternity units of hospital.

(ii).Objective of the project

- To design the development of an intelligent baby care, which has ability to monitor baby movement, bed-wet condition and body temperature.
- To make a baby cradle is safe and comfortable for baby with using PIR sensor to detect the movement of the baby body as well as bed-wet condition to keep away baby from hygienic environment.
- To make cradle innovation that is more flexible and less expensive to market.
- User friendly- simple and complete with instruction

(iii). Literature and Review

Introduction

This section will provide the details of literature review done according to our project title **“development of an intelligent baby cradle, with ability to monitor body movement, bed wet condition and body temperature”** and overview of automated baby cradle and the research about cradle and related works which has been done till now are discussed.

Manual Design

The cradle which is manually designed does not require any power supply to operate. The guardian have to cradle their child themselves whenever needed. There are many manual cradle design available in the market such as wood cradle and cloth cradle (Figure-1 & Figure-2).



Figure-1 Manual wood cradle[15]



Figure-2 cloth cradle[16]

But now days there is automatic cradle is available with the addition features[2]. This kind of extra additional feature is added to the newly Automatic cradle is beneficial for the users.

Cradle Research

According to the researcher there are useful ways to pacify and calm the baby which has given below:

- (1) Suckle a baby
- (2) Rocking motion
- (3) Singing a song

A cradle is one of the safest place for baby to comfort sleep and babies' likes the cradle and they enjoy in the cradle because they are habituate to rocking and all babies have already rocked in their mom's wombs. During the time of pregnancy whenever mother breathing and movement of mother as well as through heart beat they enjoy rocking through mentioned activity. The Vestibules is established from the 3rd month onwards and fully established at the time of birth. This the reason why baby feels comfortable whenever the cradle swings.

Related works

Gim Wong introduce and electronic gadget that can be connected to the traditional essentially mounted type crib[3]. Which is incited by the child cry voice got by the amplifier gives short toss shaking activity to bunk the pushing and pulling on the footer heard board. There is affectability control so child voice only execute the shaking action and there is clock to control the duration of rocking action.

Anritha Ebenezer gives an approach to plan to design the automatic baby cradle for cry detection[4]. Whenever analyze the sound intensity the cradle stars swings. It has approx. six times per minute.it has wet sensor to shows infant wets, at what over point infant wets resistance would change thus sending a signal. Different sensor such like temperature sensor to show baby temperature, respiratory sensor that signs in apnea condition. GSM modem has been used to send the SMS to the guardians in case baby is not stopping crying as well as in the case of bed-wet.

Yang Hu proposed calculation of altering the bassinet influencing degree by the sensor signals. The bassinet is made up of a versatile influencing gadget and different sensor system. While infant is crying, the sensor system can judge the reason as indicated by identifying the parameters, giving the distinctive signs to control circuit. In the meantime, the bassinet begins to influence marginally. The influencing mood can be balanced as indicated by the parameters from child status. They utilize three wet sensor situated in the bassinet base, one at the focus and others at left and right of the base.

Steven bang has invented automatic baby rocker having noise sensor for analyze the baby cry. Noise sensor having of Mic with a pre amplifier (2n3904 transistor). Signal from noise sensor is led to the Arduino AT mega 328, which is used to curb the Dc motor. Some colorful lights has been design by LED are used to provide entertainment to the baby while swinging the cradle. Mabuchi RE-260RA DC motor with Tamiya 6 speed gear box is used to create the swinging motion of the cradle along with gear ratio of 509.9.1. [4]

AUTOMATIC BABY CRADLE BENEFIT

The requirement of automatic intelligent baby cradle is day by bay increasing.

Especially in metropolitan cities. The benefits of Automatic cradle are:

- (a) It is very easy to operate and it's reduces the manpower work. The user can adjust the cradle according to their comfort and use.
- (b) User can adjust the time as per need of the parent's the how long cradle will move and the parents can finish their household work in that period.

(c) The one of the most benefit of this cradle is we can use cradle as a biomedical product in the hospital. Hospital have neonatal and maternity units. It will be helpful for the nurses to take care of infant and sooth whenever they need. They do not have to seat nearby.

HARDWARE DESIGN AND DESCRIPTION

The following section describes the hardware that is being used in the project.

A. Hardware Requirements

1. PIR sensor
2. Motor shield
3. Arduino UNO
4. GPRS shield
5. Surface temperature sensor
6. Wet sensor(designed on PCB)
7. Power source (9 Volt rechargeable battery)
8. Geared motor

PIR SENSOR

A passive infrared sensor is an solid sensor that measures infrared lighting radiating from objects in its field of view.. It is solid sensor or set of sensors made from pyro electric material – material which generate energy when exposed to heat. That’s why it also called pyro electric infrared sensor (Figure-3).

Features

1. Low cost, Small size
2. Easy to use and widely available
3. Easy to conceal in security application
4. Easy to interface
5. Detecting distance 10 cm to 80 cm
6. Output type – Analog voltage
7. Response time - 39ms
8. Supply voltage- 0.3 to 7 volts
9. Dissipation current- Max 35mA

Application

1. Used in motion detector
2. Indoor and outdoor lighting
3. Military and scientific application
4. Automatic light control safety
5. Used for intrusion detection



Figure-3 PIR sensor[17]

Motor shield

The Arduino Motor Shield is in view of the L298 (datasheet), which is a double full-bridge driver intended to drive inductive loads, for example, transformers, solenoids, DC and venturing engines (Figure-4). It gives a chance to drive two DC engines with your Arduino board, controlling the pace and bearing of every one autonomously. One can likewise gauge the engine current ingestion of every engine, among different highlights.

Applications

1. Robotics
2. Mechanical Application

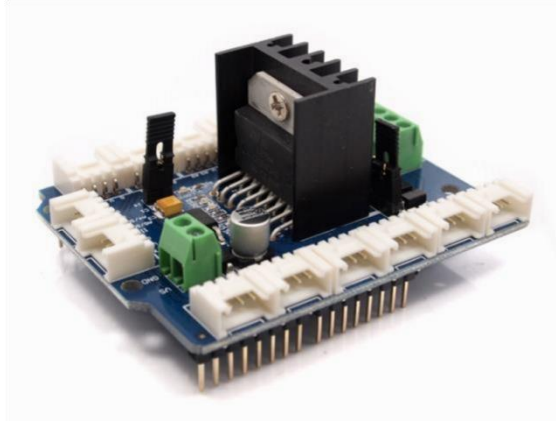


Figure-4 Motor shield[18]

Arduino UNO

Arduino is a single board smaller scale microcontroller expected to make the use of intuitive protests or situations more available (Figure-5 & Figure-6). The equipment comprise of an open source equipment board outlined around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. Current models highlight a USB interface, six simple inputs pins, and additionally 14 advanced I/O pins which permits a client to connect different augmentation sheets. Arduino Uno can sense the environment by using the sensor, sensor receive the signal from environment and send to the input part of Arduino, Arduino give the output from the output part as the programming burn in the microcontroller. Arduino accept a programming software called sketch. An Arduino can program infinite time. If a new program burn in the Arduino then previous program will automatically vanish. We can use multiple of sensor at a time and all the instruction should be in one program.

Application of Arduino

To develop any sensor based prototype equipment.

Develop any LED blinking circuit.

Xoscillo: open-source oscilloscope

- Arduino Phone
- Scientific equipment

Picture of Arduino

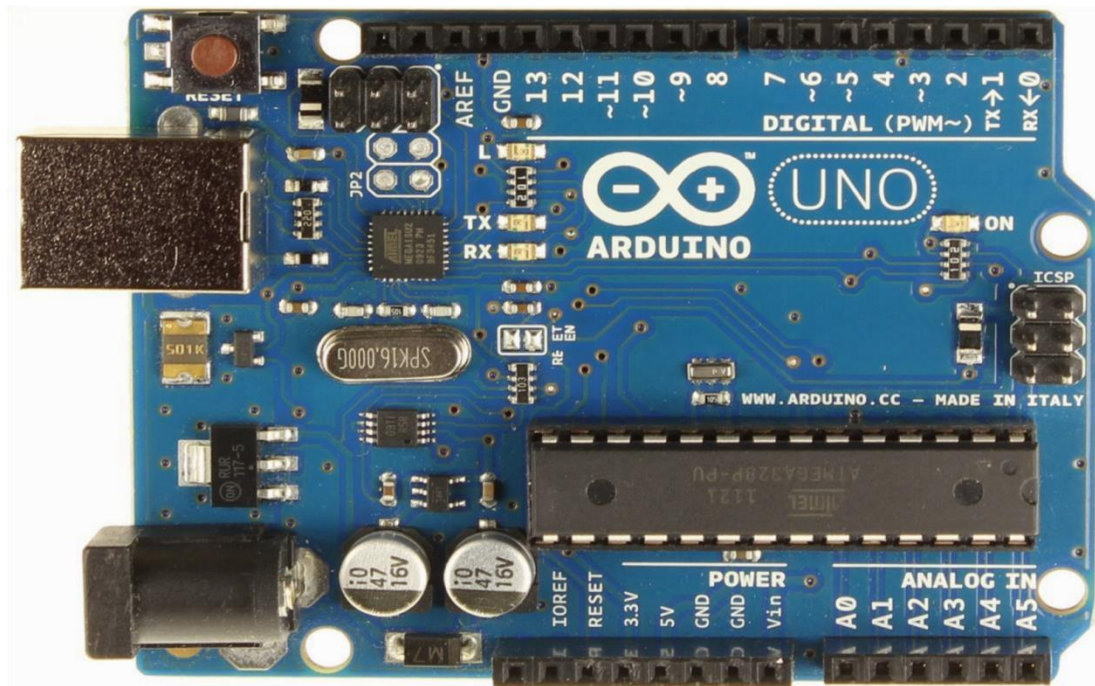


Figure-5 front view of Arduino UNO[19]

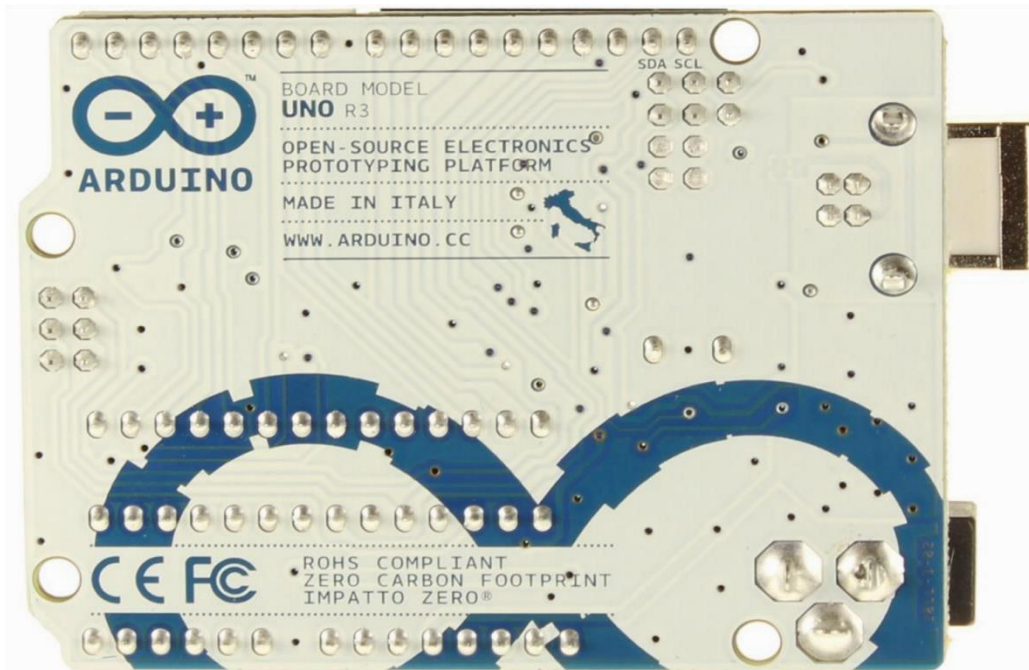


Figure-6 Rear view of Arduino UNO[20]

GPRS Shield

The GPRS Shield gives an approach to utilize the GSM cellphone systems to receive information from remote areas, the shield permits to accomplish this by means of any of the three routines.

- Short message service
- Audio
- GPRS services

The GPRS Shield is perfect with all sheets which have the same structure calculate and Pin out as the standard Arduino board (Figure-7). The GPRS Shield is designed and controlled through its UART utilizing straightforward AT summons in light of the SIM900 model from SIMCOM,

the GPRS Shield is similar to a cellphone. Other than the correspondence includes, the GPRS Shield has 12 GPIO, 2PWMS and a Audio.

FEATURES

1. Lower power consumption
2. Industrial temperature range -40 to 85 degree
3. Sim card holder and GSM Antenna
4. It can send DTMF signal or play recording
5. Based on Simcom,s SIM 900 module

Application

1. Send SMS and DTMF signal
2. Recording Audio



Figure-7 GPRS sheild[21]

Surface temprature sensor

The surface temprature sensor is used for measurement of body skin temprature (Figure-8). The surface temprature sensor has exposed thermister that results in an extremly quick time. This design allows only for air and water use.

Specification

1. Temperature range: -25 to 125°C (-13 to 257°F)
2. Maximum temperature that the sensor can tolerate without damage: 150°C
3. Accuracy: $\pm 0.2^{\circ}\text{C}$ at 0°C , $\pm 0.5^{\circ}\text{C}$ at 100°C
4. Response time (time for 90% change in reading)
 - a. 50 seconds (in still air)
 - b. 20 seconds (in moving air)
5. Temperature sensor: $20\text{ K}\Omega$ NTC Thermistor



Figure-8 surface temperature sensor[22]

Wet sensor(Designed on PCB Board)

To make a wet sensor we used a simple voltage divider to detect the resistance and if the resistance below a certain limit we will let the serial monitor print that there is moisture detected.

To develop a PCB for wet sensing first of all we dropped on HDR connector on the new file and send it to the ultiboard and there we draw the sensor layout like this (Figure-9).

1. Printed the layout in PDF format on a glossy paper
2. Took a copper bottom PCB board and put the printed circuit on it and ironed the paper so that circuit could be printed on the PCB
3. Then putted PCB in ferric chloride solution and shook for about an hour or more until all the copper on the board was gone except the print
4. Then removed the carbon of the print by washing it with a scrub and only a layout of copper has left
5. Then applied soldering flux on the copper layout and lined it with soldering.
6. After that connector was fixed and soldered and the PCB for moisture detection has completed.

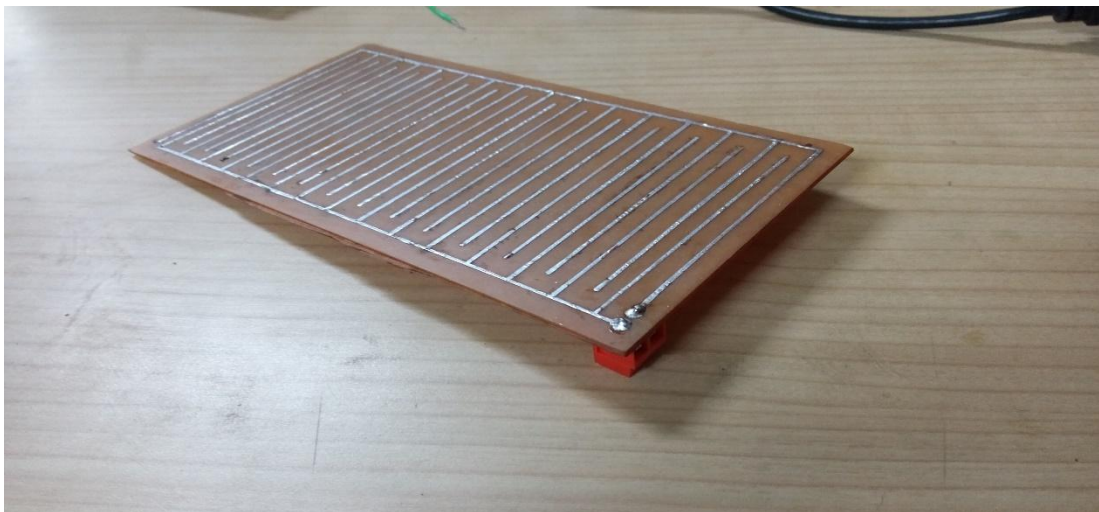


Figure-9 PCB for wet sensing

POWER SOURCE

Here I have used 2 power source for each system (Figure-10). Since Arduino need 9 V input power maximum so the most common 9 volt dc power source is transistor battery. I can operate my prototype by using this battery is around 30 minutes. It is small in size weightless and easy to carry with this prototype.



Figure-10 Picture of battery[23]

Geared motor

The “gear motor” or “geared motor” is a motor having an attached ”gear assembly” (or gear train) which enables the gear motor to provide greater torque at a lower rpm than the motor alone would be capable of providing (Figure-11). In our experiments however, we didn’t need the gear assembly. We used a 300 rpm, 12V motor to control the speed and direction.

Features

1. Low cost
2. High gear ratio and torque output

3. Compact
4. Balanced load distribution

Application

1. Automotive applications
2. Robotic applications
3. Used in industry
4. Power winches on trucks

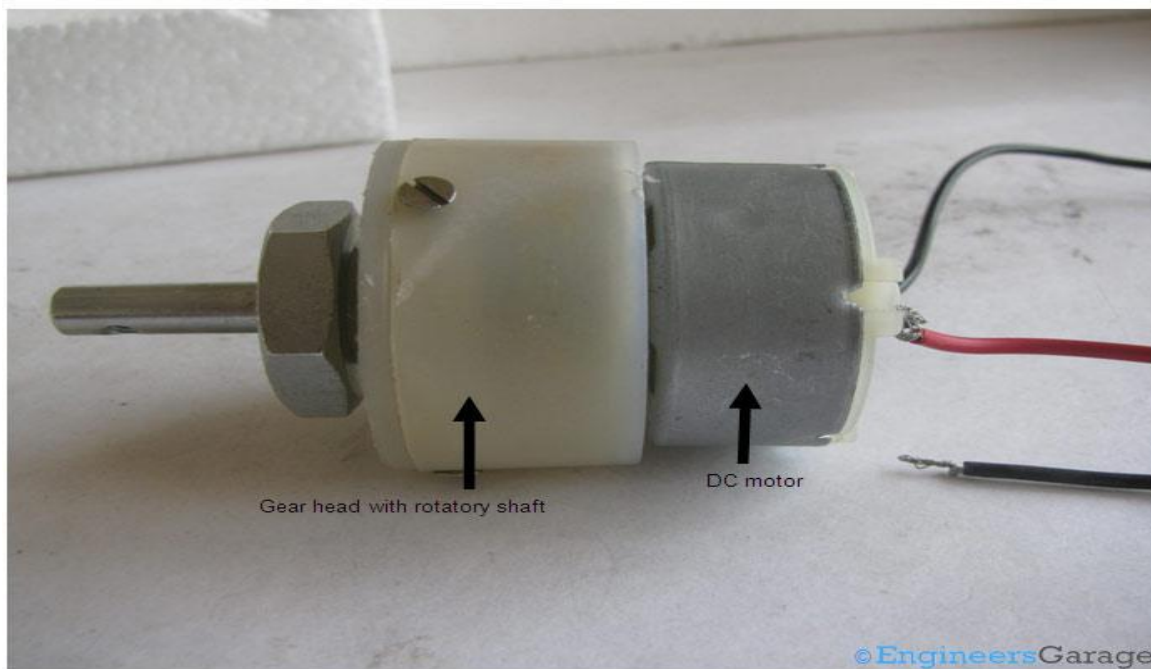


Figure-11 gear motor[24]

CHAPTER-2 Materials and Method

The material that has been used in this project is given below:

- (1) PIR sensor
- (ii) Arduino Uno
- (iii) GPRS shield
- (iv) Shield Motor
- (v) Geared motor
- (vi) Single sided copper cladded board
- (vii) Vernier surface temperature sensor
- (viii) The two 9V power supply

(1) PROCURED AND PURPOSE OF MATERIAL

(1) PIR Sensor- The PIR sensor has been used the model HC-SR501 in this project to detect the baby movement and procured from the local store[5].

(ii) Arduino UNO- Arduino UNO is the microcontroller board and the Arduino AT MEGA 328 model has been used in this project and procured from the local store. And arduino has been used for the quickly developed interactive objects, taking input from variety of switches or sensors and controlling a variety of outputs such as automate the motor and detect the temperature sounds and light this is called physical computing[6].

(iii) GPRS Shield- GPRS shield has provides the use in the GSM cell phone module to receive information or data from the any location in this project the SIM 900 module has been used to send the SMS to the parents and procured from the local store[7].

(iv) Motor shield- The arduino motor shield has been used and it is based on the H-bridge chip L 298 driver integrated circuit .this motor shield mount with arduino and enable the geared motor which help in swing of cradle. This is procured from the local store[8].

(v) As the name implies, a “gear motor” or “geared motor” is a motor having an attached ”gear assembly” (or gear train) which enables the gear motor to provide greater torque at a lower rpm than the motor alone would be capable of providing. In our experiments however,

we didn't need the gear assembly. We used a 300 rpm, 12V motor to control the speed and direction and it is also procured from the local market or store.

(vi) Single sided copper cladded board- The copper cladded board has been used for the wet detecting as a wet sensor. The PCB designed for wet sensor on the copper cladded board are also procured from the local market[9].

(vii) Vernier surface temperature sensor- The surface temperature sensor of model STS-BTA has been used that has exposed thermistor to detect the quickly temperature. It has also procured from the local market[10].

(viii) 9V power supply- the two 9V power supply has been used in this project of the energizer company. It has been used to give power supply to arduino to function of the prototype.

(ii)DESIGNING OF THE CRADLE MODEL

A schematic of the model of the prototype is shown in Figure-12.

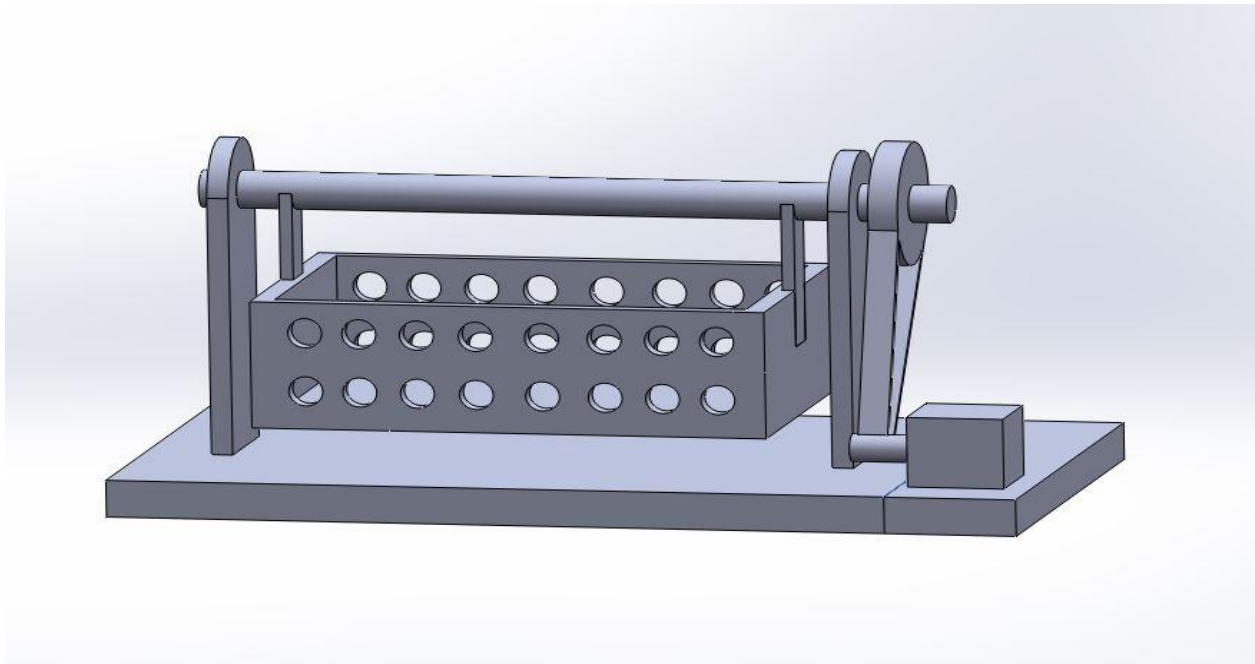


Figure-12 Prototype of cradle

(iii)IMPLEMENTATION OF THE PIR SENSOR MONITORING SYSTEM

Pyro electric infrared (PIR) sensor is a strong state sensor which is fit for catching infrared radiation emanating from the objects[11]. The sensor fundamentally measures the adjustments in the infrared radiation amid development of the items, set with in the field of perspective of the sensor. Since the sensor is equipped for distinguishing articles while they are in movement, they are regularly viewed as movement finders. In this study, PIR sensor was appended on the pole of the support in order to identify the development of the child. Once, the development of the infant is recognized, a control sign was created to swing the support for the 5 minutes. In the event that the sensor recognized the development of the infant after the progression of the swing stage, the swing was rehashed for an additional five minutes.

(iv)IMPLEMENTATION OF THE BED-WET SENSING SYSTEM

A mesh like structure was produced on to a copper clad board the cross section was comprised of two leads with extended structures. The expanded structures of the leads don't cover one another. In other vicinity of Bed-wet condition, the leads was associated with a 5V force supply through the resistance of 55 kilo-ohm. The second lead was joined with the ground. The yield of the framework was taken from the 55kilo-ohm resistance and the lattice lead. The yield was associated with the AIO information of the Arduino UNO board. Under typical circumstances the lattice surface will carry on as open circuit and the yield of the sensor will be 5V. On account of Bed-wet condition, there will a drop in the yield voltage. A not as much as rationale was connected to produce a control signal for the actuation of the GSM module.

(V)IMPLIMENTATION OF SURFACE BODY TEMPRATURE MEASURING SYSTEM

Observing of the body temperature of the new conceived children is of awesome significance, particularly for the untimely and basically sick babies[12]. Remembering this numerous scientists are attempting to create temperature checking framework. In this paper, a NTC thermistor was utilized for outlining a temperature checking framework. Among a wide range of temperature sensor, most dependable ones are thermistors. Thermistors are fundamentally ceramic semiconductors which have negative warm coefficients, i.e., the resistance of thermistor is nonlinearly and conversely identified with the temperature which permits to focus little temperature variety at lower temperature range. The surface temperature sensor STS-BTA is an

uncommon kind of thermistor which has the extra thermistor to detect the temperature it has benefit of high accuracy and flexibility. It is limited uses in water and air. The sensor has 15k-ohm NTC thermistor, which is governed by stein-hart equation

$$T=[K0 + K1 (\ln 1000R) + K2 (\ln 1000R)^3]^{-1} -273.15$$

Where

T= temperature, R= measured resistance in kilo-ohm, K0= 000.102119 K1=0.222468
K2=0.000000133342

To calculate the resistance the following equation has been used float resistance = (10000 * voltage) / (5.0 - voltage) to calculate temperature Use these values for A, B, and C till we get everything working, and then do some measurements to calibrate thermistor in circuit.

Float log cubed = Log (resistance);

Log cubed = log cubed * log cubed * log cubed;

Float kelvin = 1.0 / (-7.5e-4 + 6.23e-4 * log (resistance) - 1.73e-6 * (log cubed))

To Convert to Fahrenheit we have used this equation

Float f = (kelvin - 273.15) * 9.0/5.0 + 32.0; [5]

The following above equation was used for converting the voltage signals recorded to temperature signal. The output of the temperature sensor was fed to the A1 channel of the arduino Uno board.

A greater than equal to logic was applied to determine whether the body surface temperature was above the preset level of 40.degree Celsius. In the event of the temperature reaching 40 degree Celsius or above resulted in the generation of a control signal to activate a GSM module.

(vi) ASSEMBLY THE DIFFERENT MONITORING SYSTEM

The different monitoring systems were merged together so as to have an automatic cradle which can initiate the swing in the presence of the movement of the child. The integrated system was able to detect the Bed-wet and body temperature of the child. In the event of either bed-wet,

increased temperature the GPRS Shield was activated to send a SMS to the users. The flow chart of the device has been shown in Figure-13.

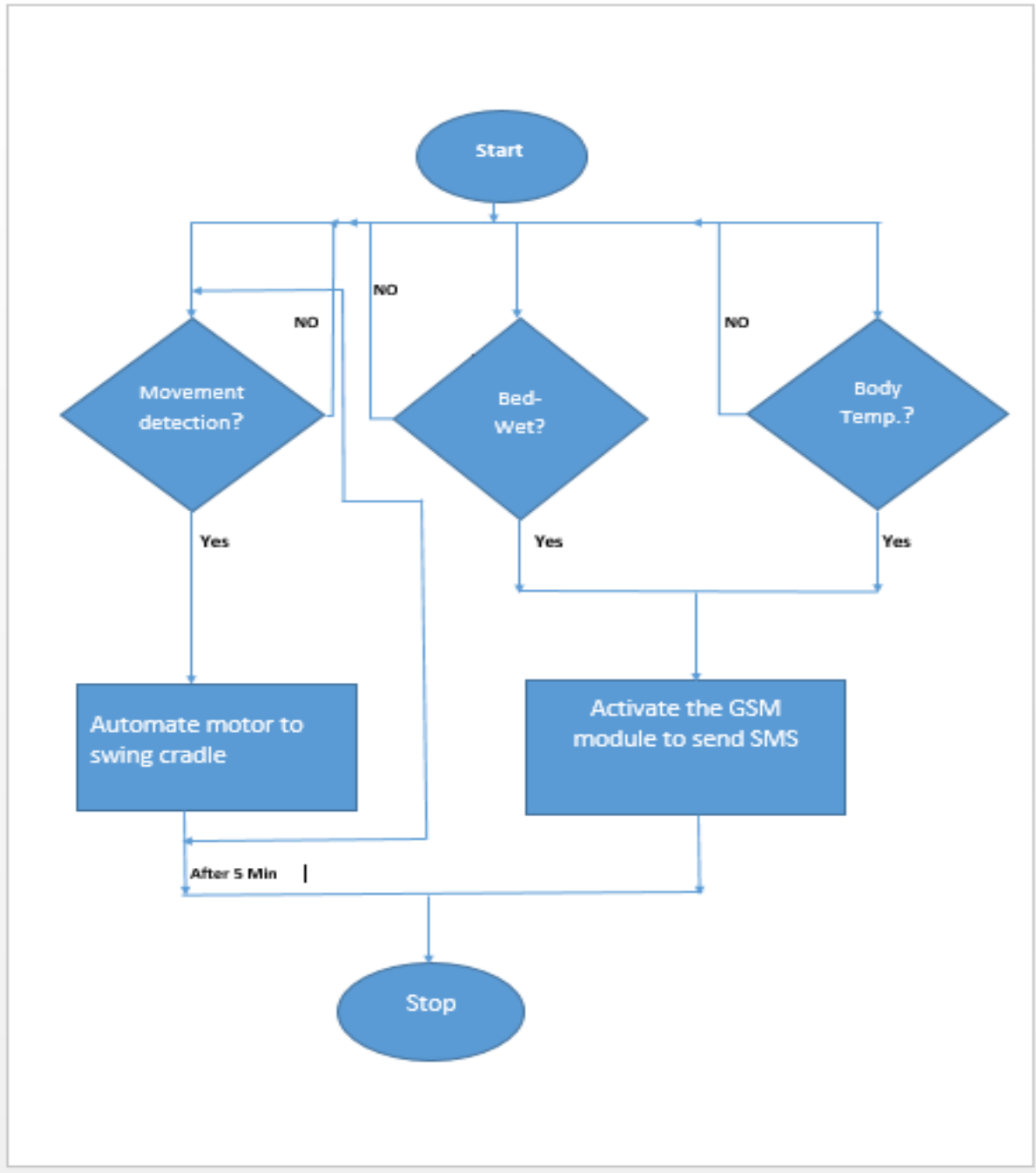


Figure-13 flow chart of the system

Chapter-3 Result and Discussion

(i) The Assembled Device

The individual devices were assembled and and was observed to be working efficiently in the event of the movement (simulated by moving a hand of the PIR sensor), the started to rock. When Bed-wet and hyperthermia conditions were simulated individually, the developed device was able to send SMS to the users.

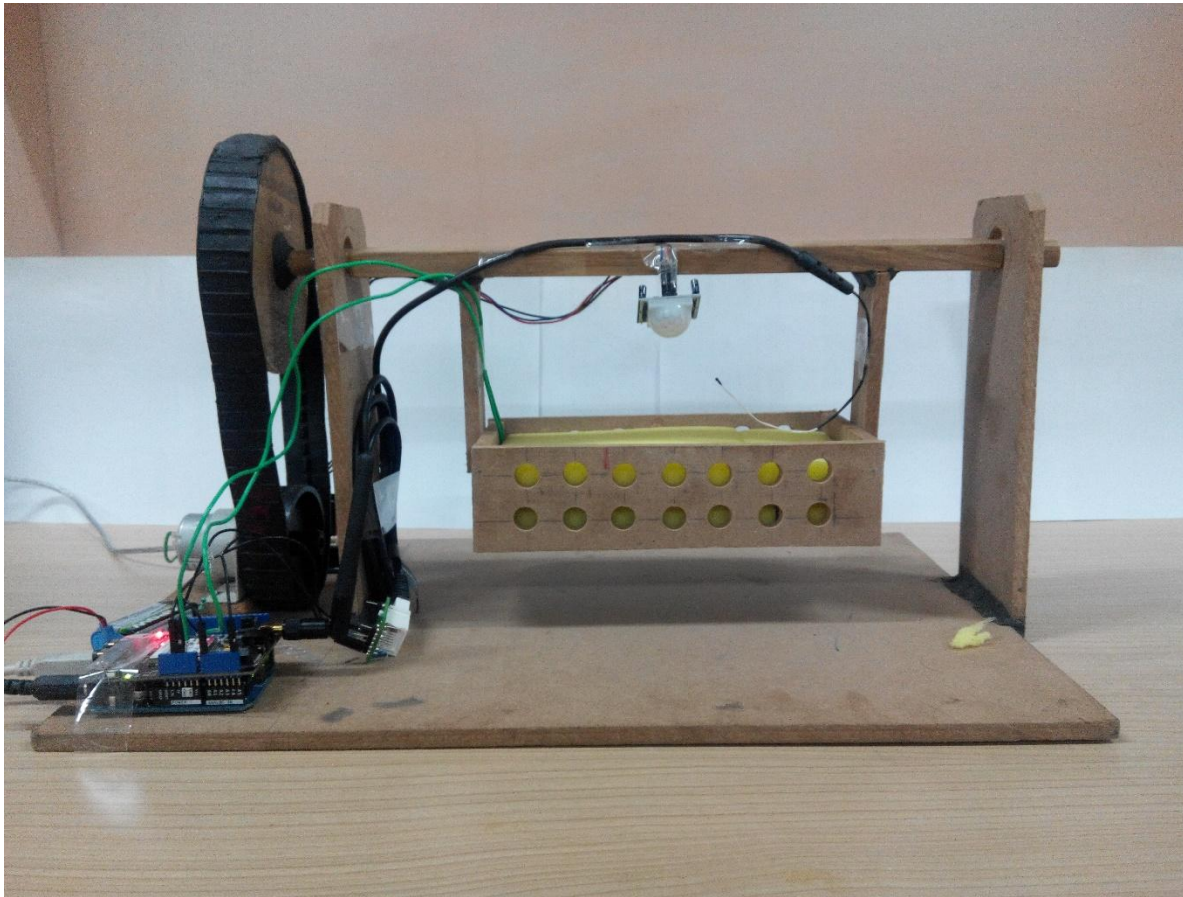


Figure-17 Assembled device

Chapter-4 Conclusion

CONCLUSION

In the present study, an intelligent baby cradle system was developed. The cradle was capable of detecting the movement of the baby and initiate cradle swing. Additionally, in the event of Bed-wet or hyperthermia, the developed device is capable of sending SMS. The device can be used to minimize the workload of the parents and nurses in home and hospitals respectively.

Chapter- 5 Future Scope and References

(1)Future scope

In future we can add more features to make more efficient and user-friendly. The feature we can add to this device such like parents can monitor their baby live via 3G, rotating toy with music and camera, and the sound detector to detect sound of the baby could be added to enhance the system features. With the development of technology daily routine has been eased for the parents along with the baby care. Otherwise motherlap's will be the best cradle for baby.

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