# "IOT Smart Cradle System for Infant Monitoring"

Gurram Vijay, Student, Dept. Of Computer Science
P Supreeth Gupta, Student, Dept. Of Computer Science
Srineeth V, Student, Dept. Of Computer Science
Naman S, Student, Dept. Of Computer Science
Rajesh Kumar S, Assistant Professor, Dept. Of Computer Science
Cambridge Institute Of Technology

**Abstract** - This project is focused on an idea to design a Smart Cradle System using IOT which will help the Parents to monitor their child . The design of smartness & innovation comes with the use of technologies methodologies which include Internet of Things (Modules like Raspberry Pi, Humidity and Temperature sensing), Live Video Surveillance, User Friendly Web application . In order to detect each & every activity of Baby, different Sensors or Modules are attached to the Cradle: Humidity and Temperature Sensing Module for detection of Wetness of the bed, A Camera on top of the Cradle for live video footage.

***Key words***: IOT, Raspberry pi, Humidity, Temperature, Video Surveillance, Web application.

## 1. INTRODUCTION

As we are very well familiar with the hurdles faced by Parents to nurture their infant and especially in case if both the Parents are working. To give 24 hours of time in such cases is next to impossible. Thus, we should develop something unique that can help Parents to have a continuous surveillance on the Baby/Infant and can notify about the same. Thus, we came up with an idea to design a Smart Cradle System using IOT which will help the Parents to monitor their child even if they are far away from home and can detect every activity of the Baby from any distant corner of the world. It is an innovative, smart & protective Cradle System to nurture an infant in an efficient way. This system considers all the minute details that are required for the care and protection of the Baby in the cradle. The design of smartness and innovation comes with the use of technologies methodologies which include Internet of Things (Modules like Raspberry Pi, Humidity & Temperature sensing), Swing Automation, Live Video Surveillance and User Friendly Android Mobile Application. In order to detect each and every activities of the Baby, different Sensors or Modules are attached to the Cradle: Humidity and Temperature Sensing Module for detection of Wetness of the bed, A Camera on top of the Cradle for live video of a footage and Cry Detection Circuit to analyse Cry Patterns which eventually triggers the swinging mechanism (if required based on the range of frequency). All the data which is been taken from the sensors or modules will be stored. An instant mobile notification that will be generated if any abnormal activity is detected in the Android Mobile Application which has been Developed. It has UI controls which include the feature of controlling the swinging mechanism of the cradle), control for the switching on the camera live footage & controls for playing the toy/projector whenever the baby cries.

### 1.1.1 EXISTING SYSTEM

The proposed smart cradle has comprised of three modules; input module and processing module. The sensor module consist of temperature sensor and humidity sensor. The processing unit is processing the values and comparing with threshold values, generates the alert if necessary.

### 1.1.2 PROPOSED SYSTEM

The proposed design has utilize IoT facility for communication.. There are extensive quantities of software design dialects which have been adjusted for Raspberry Pi. Python program design language is suggested by The Raspberry Pi establishment particularly for the learners. Essentially any program design language which can be arranged for ARMv6 can run on the Raspberry Pi.The sensed data is stored. The stored data can be processed for threshold values using machine learning. After gathering the readings from sensors, the Raspberry Pi makes a decision to speaker on to parents if baby has been crying for more than 5 min based on the data collected. The Raspberry Pi is programmed in this sort of way that if the readings have the crossed the secure range, the guardians are alerted. The principle goal of this smart cradle is to serve of the baby. The modelling phase is followed by the system design, determining the GUI of applications, and prototype phase. The system design is separated into two phases, namely, the cradle design and control system design. A cradle prototype for the baby monitoring system was designed. In the control system design, the types of electronic components were determined and purchased for implementation in the system.

## 2. Related Work:

Three are many works are done in implementing a smart cradle. The recent works on Smart cradle uses IoT for communications.

Steven Bang et a. [3] proposed a cradle with baby cry recorder. The authors used 2n3904 transistor. The noise was filtered by Arduino microcontroller. The presented design had colorful lights and recorded facility. It had camera for recording. Their model did not had live stream facility.

Yang Hu et al. [4] reported an algorithm to convincing the baby cry by sensor signals. They have used adaptive algorithm for sensor networks. The baby cry was recorded and analyzed for the cause. The type of the cause were stored in the database. The identified cause was compared with the list of causes. The appropriate action was executed based on the cause as identified. The movement arm can make a movement as the baby likes it. The rhythm was decided based on the baby's crying. Three sensors were used to detect and control the motion of the cradle arm.

Gim Wong et al. [4] reported a device for cradle. The baby cry was ignited the sensors in the device, the device was generated necessary movement in the cradle to make the baby comfortable.

Chau-Kai-Hsieh et al. [3] reported a amplifier based baby cry finder. They have used a pulse circuit to identify the baby cry. The pulse circuit had signal processing capability to identify the baby cry.

Anritha Ebenezer et al. [1] provided a method for handling baby cry. They designed a cradle with six rocks with sensors. The cradle swing depends on the intensity_of_the cry of the baby. They have used sensors to measure the temperature and wetness of the bed. They have used GSM modem for communication. They have experimented the cradle with prototype and found that the cradle requires a human intervention for some situations which h might arises occasionally.

Anish M.N et al.[2] have presented a design for cradle which oscillate automatically based with certain speed based on the identified sound. They have used DC motor for swing the cradle. They have also provided a warning message as SMS to the parents when the baby cry for a long time. The cradle had patting unit for baby. Their system was semi-automatic and hence require human intervention partially. They have experimented the cradle with the prototype. Their prototype was able to fulfill the needs of the baby. They claimed that the cradle was working for t expectation.

Rachana M S et al. [1] have reported a physically connected system which claimed that no human intervention is required for communication. Their cradle swing when the baby cry, the cradle were also able to sing a song through speaker. They have synched web page through hardware component which mounted in the

cradle. They have used many sensor for temperature measuring, moisture measuring, sound measuring in the design of cradle.

Few studies have investigated the possibilities of automated baby cradle using different perspectives. A baby monitoring system has been proposed in [5], in which an enhanced noise canceling system that monitors the baby and reduces sound pollution has been suggested. The main function of the system is to reduce the noise that might disturb the baby by playing relaxing songs. This system can also adjust the room's light intensity with the aid of a light sensor. However, our system has more advanced features, such as supporting real-time monitoring over the IoT network and vision monitoring using web camera.

Goyal and Kumar [4] introduced an E-baby cradle that can swing automatically when it detects crying and stops swinging when the crying stops. The speed for the swinging cradle can be controlled based on the user's need. It has an alarm embedded in the system, which notifies the user when two conditions occurred. First, the alarm goes off when the mattress is wet, indicating that the mattress should be changed. Second, when the baby does not stop crying for a certain time, the alarm alerts the parents to attend to their baby. However, it is only applicable when parents are near the cradle, because it only uses a buzzer alarm, the sound of which might frighten the baby. Parents cannot monitor their baby when they are away from home, for example when at work or when traveling to other places. A similar automatic baby monitoring system was proposed in [1]. The authors developed a low-budget system that swings the cradle when the crying sound is detected, and the cradle stops when the baby stops crying. The built-in alarm goes off under either one of the following conditions: the mattress is wet or the baby does not stop crying after a certain period. A video camera is placed above the cradle to monitor the baby. However, the parents can only receive the notification via SMS and cannot control the system.

Therefore, the proposed system in the current study is more advanced, because it utilizes an IoT application to monitor and control the developed smart cradle in real time anywhere and anytime. A ball bearing design is adopted to reduce system damping and allows the cradle to swing freely even without electricity. Subsequently, an appropriate sensor is designed to detect the swinging status or angle. SD card stored in an SD module. However, such local control [2] designed a system for baby monitoring based on Raspberry Pi and Pi camera. The designed system can spot the motion and crying condition of the baby. They used condenser MIC to spot the crying condition and PIR motion sensor to spot the baby movement with the help of Pi camera. The camera is turned on only when the condenser MIC detects a sound and sends a signal to Raspberry Pi.

## 3.SYSTEM ARCHITECTURE

System architecture is that the conceptual design that defines the structure and behavior of a system. An architecture description may be a formal description of a system, organized during a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides an idea from which products are often procured, and system developed, which will work together to implement the general system. The Raspberry Pi is a little single-board processer. The raspberry Pi is used as a controller and constrained by all sensor. The humidity ssensor is utilized here to screen the dampness variety of nature on the bed. The DHT11 uses impartial one wire for communication. The current stages with convinced time regard exemplify the justification one or justification zero on this pin. The communication process is separated in three phases, first is to refer solicitation to DHT11 sensor then sensor will send reaction heartbeat and afterwards it starts sending info of all out 40 bits to the microcontroller. The communication has begin with the start pulse. The start pulse send to the DHT11 sensor for starting the communication. The Temperature Sensor detects the temperature ascend in the framework. LM35 is a temperature guessing device having a unassuming yield current corresponding to the temperature. It gives harvest power in Centigrade (Celsius). It does not require any outside alignment computer hardware. As temperature expands, yield power additionally increments. The LM35 is utilized for measure the temperature level on the bed. The live capturing is done by mounted camera.

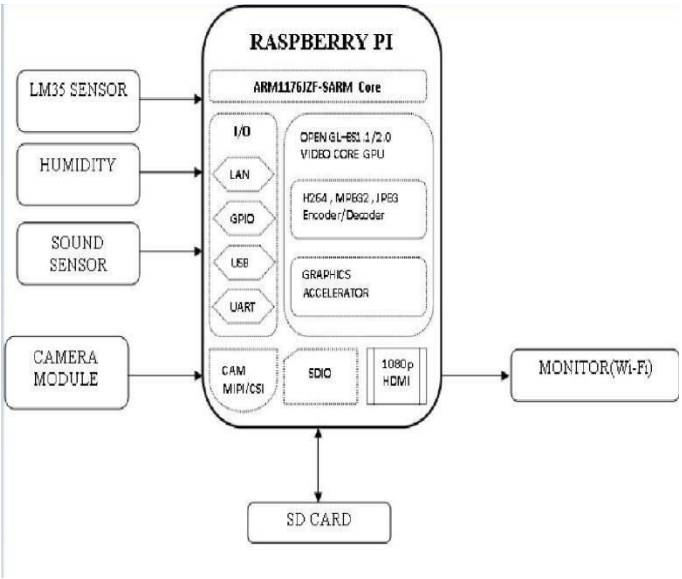


**Fig.3.1 : Sequence Diagram**

Hardware requirements: Sound sensor, Camera, Speaker, Moisture sensor, Motor driver,Motors, Power Supply, Raspberry Pi. Software requirements: Python , Language – Linux, Raspbian Jessie. The sequence diagram shows all the components connected to the Raspberry pi to work collectively and keep the infant checked.

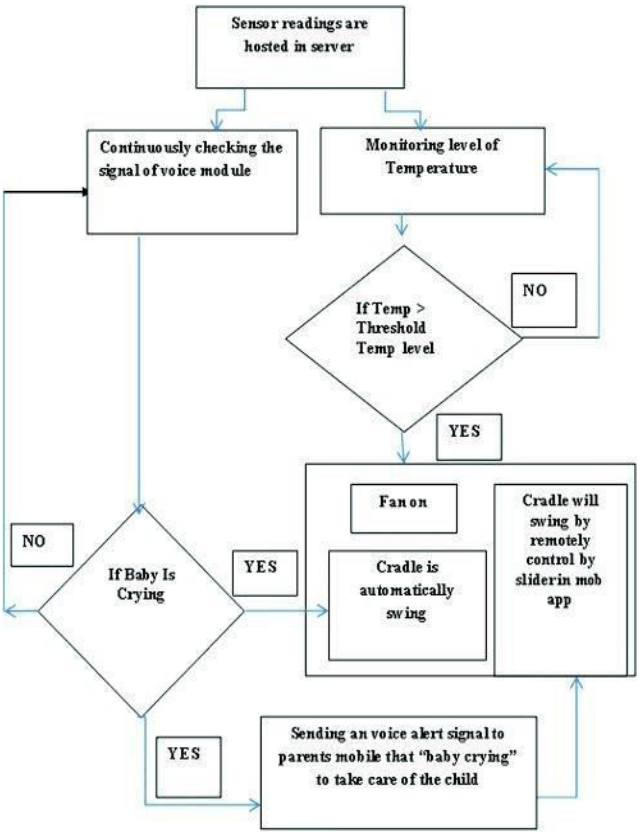


**Fig.3.2 : Proposed System Architecture**

The sound module is utilized for cry finding circuit to examine cry designs. All the information which has been taken fromthe devices/components will be put away in Cloud. The sound sensor is one kind of component used to check the sound, this component is utilized to recognize the force of sound.

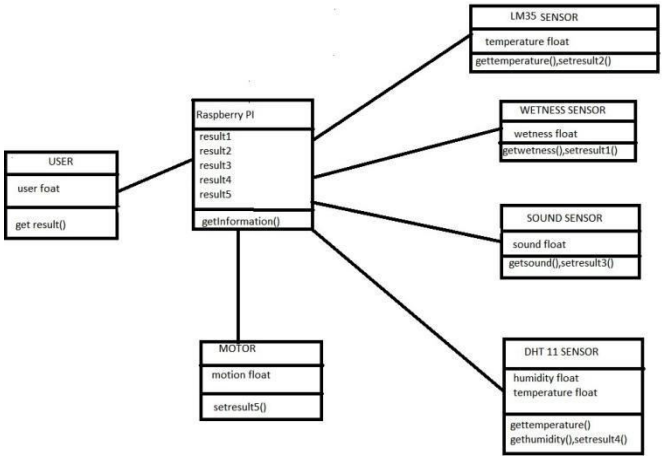


**Fig.3.3 : UML Model of Proposed System**

## 4.METHODLOGY

The raspberry Pi is used as a controller and constrained by all sensor. The communication has begin with the start pulse.The humidity sensor is utilized here to screen the dampness variety of nature on the bed. The Temperature Sensor detects the temperature ascend in the framework. The live capturing is done by mounted camera.

### 4.1. ADVANTAGES

It is a cost efficient model. It is also a user friendly model when considered its easy interface and setup. The cradle Ensures safety and minimum manual work. The baby can sleep comfortably and stay healthy.

## 5.IMPLEMENTATION

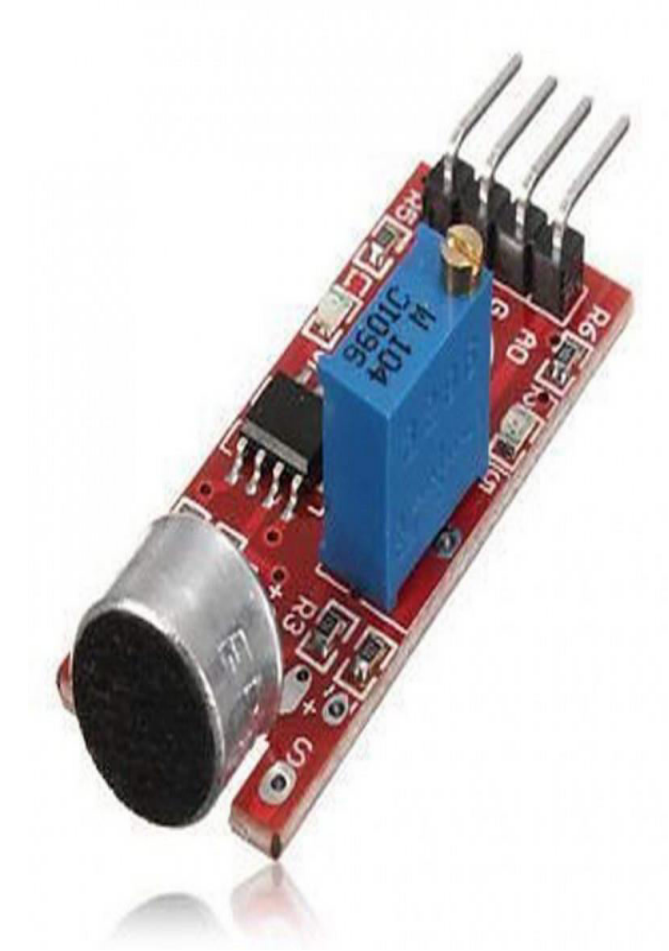


**Fig.5.1 : Sound Sensor**

Sound Detection Module Sensor for Intelligent Vehicle Compatible with a Single channel signal output Sensor. The output is effective to the low-level sound signal with good fidelity, when there is sound, outputs low level and signal light. It can be used for Acoustic control light, give sound and light alarm working with the photosensitive sensor, and sound control, sound detect. (The Maximum induction distance is 0.5M)

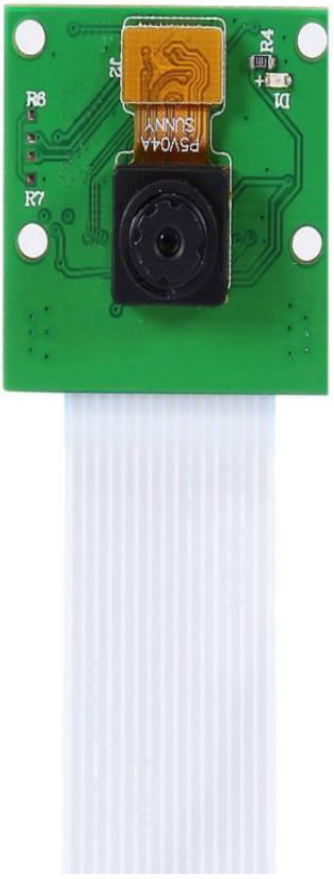


**Fig.5.2 : Raspberry Pi camera**

The 5MP Raspberry Pi 3 Model B Camera Module with Cable equips flexible cable for attaching with Raspberry Pi 3 Model B. The 5MP camera module is perfect for small Raspberry Pi projects which have very little space allowance just boot up the latest version of Raspbian and you are good to go. The high-definition 5MP camera delivers outstanding photos but can also shoot video, ideal for drones or a CCTV project. The lightweight camera module allows for it to be used in more practical roles, such as a hidden camera or even a camera for a Pi-phone, for example. This Raspberry Pi Camera Module is a custom designed add-on for Raspberry Pi. It attaches to Raspberry Pi by way of one of the two small sockets on the board upper surface. This interface uses the dedicated CSI interface, which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data. The board itself is tiny, at around 25mm x 23mm x 8mm. It also weighs just over 3g, making it perfect for mobile or other applications where size and weight are important. It connects to Raspberry Pi by way of a short flexible ribbon cable. The camera connects to the BCM2835 processor on the Pi via the CSI bus, a higher bandwidth link which carries pixel data from the camera back to the processor. This bus travels along the ribbon cable that attaches the camera board to the Pi. The sensor itself has a native

resolution of 5 megapixels and has a fixed focus lens onboard. In terms of still images, the camera is capable of 2592 x 1944 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video.


**Fig.5.3 : Speaker**

This speaker cone is the perfect addition to any small audio project where you need an 8 Ω impedance and will be using 0.5W or less of power. We particularly like this cone as it's very simple and its metal body is extremely lightweight. A small audio speaker that is ideal for radio and amplifier projects and is small enough to fit in robot projects.

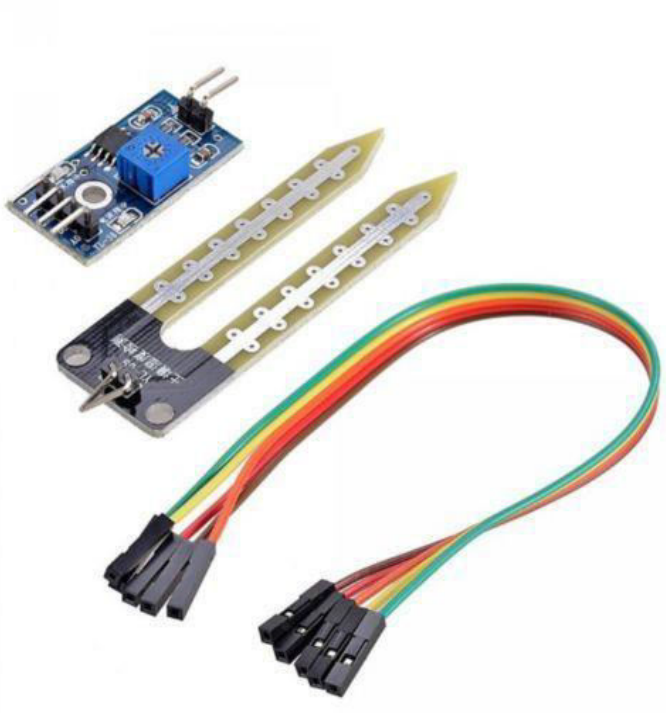

**Fig.5.4 : Moisture Sensor**

This is Soil Moisture Meter, Soil Humidity Sensor, Water Sensor, Soil Hygrometer for Raspberry Pi. With this module, you can tell when your plants need watering by how moist the soil is in your pot, garden, or yard. The two probes on the sensor act as variable resistors. Use it in a home automated watering system, hook it up to IoT, or just use it to find out when your plant needs a little love. Installing this sensor and its PCB will have you on your way to growing a green thumb. The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance.

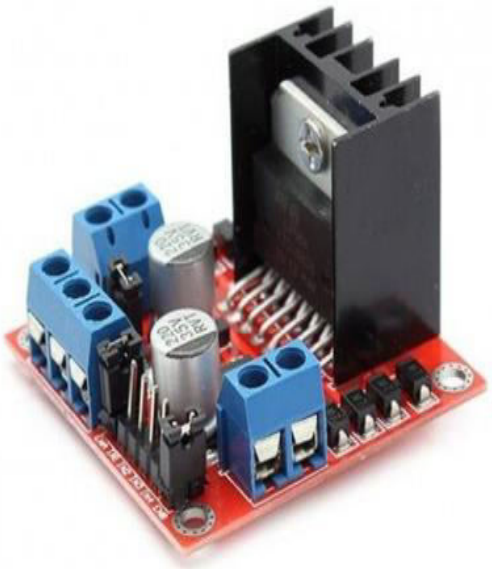

**Fig.5.5 : DC motor driver**

L298N 2A DC Motor Driver Module is a high power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L298N motor driver IC and has on board 5V regulator which it can supply to an external circuit. It can control up-to 4 DC motors, or 2 DC motors with directional and speed control This motor driver is perfect for robotics and mechatronics projects and perfect for controlling motors from microcontrollers, switches, relays, etc... Perfect for driving DC and Stepper motors for

micro mouse, line following robots, robot arms, etc..

- Out1: Motor A lead out
- Out2: Motor A lead out
- Out3: Motor B lead out
- Out4: Mo (Can actually be from 5v-35v, just marked as 12v)
- GND: Ground
- 5v: 5v input (unnecessary if your power source is 7v-35v, if the power source is 7v-35v then it can act as a 5v out)
- EnA: Enables PWM signal for Motor A In1: Enable Motor A
- In2: Enable Motor A

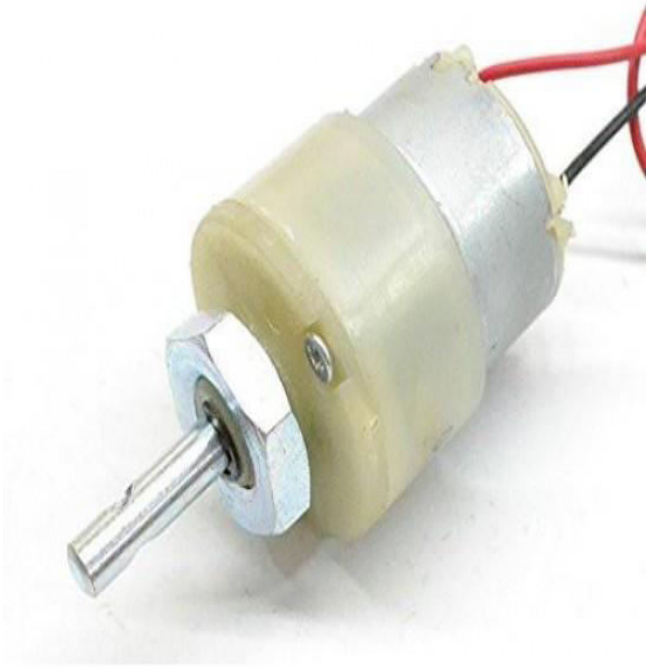

**Fig.5.6 : DC motor**

30 RPM Centre Shaft DC Motor is high quality low cost DC geared motor. The whole assembly is covered with a plastic ring. DC Motor – 30RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

30 RPM 12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size. Also, you don't have to spend a lot of money to control motors with a Raspberry pi or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC or you can choose the most precise motor diver module from the wide range available in our Motor diver's category as per your specific requirements.

Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel. DC Geared motors with robust metal gearbox for heavy-duty applications, available in the wide RPM range and ideally suited for robotics and industrial applications.Very easy to use and available in standard size.

The following snapshots show the model designed as a prototype of all the modules of the smart cradle.

**Fig.5.7 : Assembling**

**Fig.5.8 : Connections**

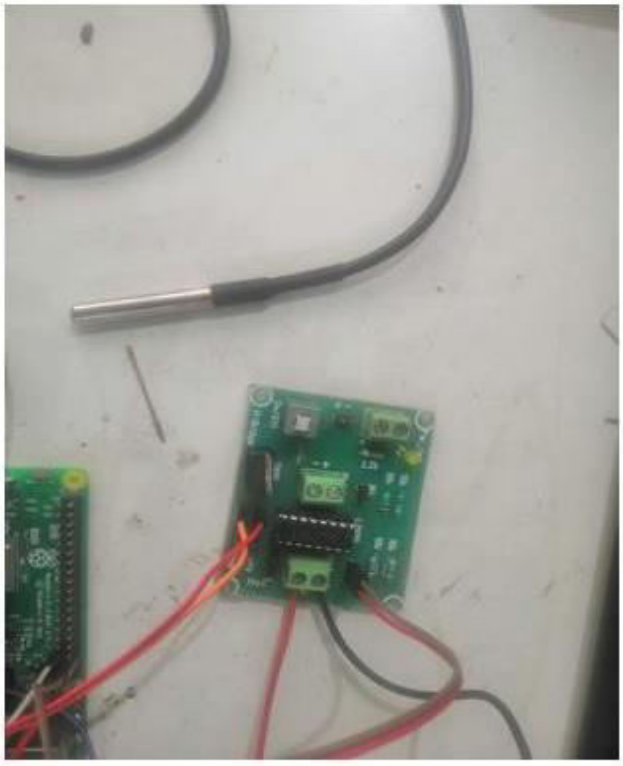

**Fig.5.9 : Implementation**

## 6. CONCLUSION

The need for smart cradle to the working parents has been addressed by designing a prototype of smart cradle. Our proposed system aims at monitoring the vital signs of the baby such as heartbeats and body temperature using wireless technology and textile sensors which are comfortable for the baby to wear and also accurate and precise than other sensors. We also focus on increase the scope of transmitting the information over the internet in order to provide remote access. The camera module incorporated enables displaying the visual feeds of the whereabouts of the baby and keeping an eye over their movements in a finite area. This system overcomes the drawback of the existing systems which are clumsy, less user friendly and expensive. This automatic baby cradle would let the working mother to do household works besides taking care of baby at the same time.

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