

SMART BABY CRADLE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Information Technology

by

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DEPARTMENT OF INFORMATION TECHNOLOGY
SCHOOL OF COMPUTING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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MARCH - 2021



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DEPARTMENT OF INFORMATION TECHNOLOGY

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Aarthy G (38120001)** and **Catherine Jenifer (38120022)** who carried out the project entitled “SMART BABY CRADLE” under my Supervision from November 2021 to April 2022.

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DECLARATION

I **Aarthy G (Reg no:38120001)** and **Catherine Jenifer (Reg no:38120022)** hereby declare that the Project Report entitled **Smart Baby Cradle** done by me under the guidance of **Dr. Saravanan M.E, Ph.D.**, is Submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in INFORMATION TECHNOLOGY.

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ABSTRACT

The standard Automatic child cradle frameworks are excessively costly and don't provide any utility. This project aims to assist mothers who are overburdened and do not have a cleaning professional or sitter to care for their children. It includes a side-to-side rocking action that relaxes and soothes the infant. Parents must use considerable effort to physically rock the cradle in order to induce swinging motion. When the infant is kept in the cradle, the parents must constantly monitor him or her to keep track of the baby's activity. The suggested concept of this smart cradle prototype will allow the cradle to be efficiently integrated. All of the sensors and hardware components will be assembled using an Arduino microcontroller. The infant within the cradle will be constantly monitored. If any action occurs, such as urinating or a baby waking up from sleep, an SMS message will be sent to the parent's mobile. The Smart cradle will also include other characteristics such as autonomously swaying the infant using a geared motor system. In addition, certain further features, such as a PCB for sensing moist conditions, will be included to improve the cradle's efficiency. The cradle is ideal for parents who are unable to spend their entire day at home sitting next to their newborn. This cradle may also be used in a maternity hospital as an aid to the workers who are in charge of the baby's care.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Generally, the baby cradle is used for to make sleep and soothe to baby. For example guardian has 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. 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.

1.2 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

As its name suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to perform a specific task. For example, a fire alarm is an embedded system; it will sense only smoke. An embedded system has three components:

- It has hardware.
- It has application software.

It has Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies. RTOS defines the way the system works. It sets the rules during the execution of application program. A small-scale embedded system may not have RTOS. So, we can define an embedded system as a Microcontroller based, software driven, reliable, real-time control system. Characteristics of an Embedded System

Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.

Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.

Reactive and Real time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay.

Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or deaccelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.

Microprocessors based – It must be microprocessor or microcontroller based.

Memory – It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.

Connected – It must have connected peripherals to connect input and output devices.

HW-SW systems – Software is used for more features and flexibility. Hardware is used for performance and security.

1.3 OUTLINE OF THE PROJECT

1.3.1 EMBEDDED SYSTEM

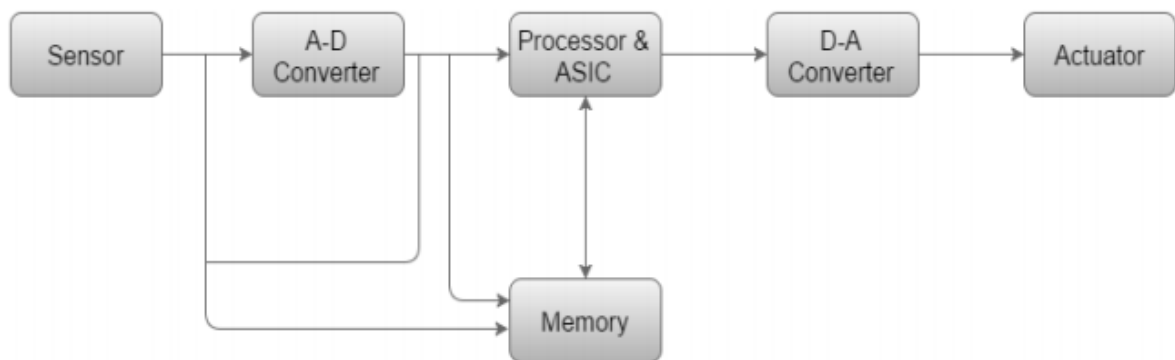


Figure 1.1 Structure- embedded system

Sensor – It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.

A-D Converter – An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.

Processor & ASICs – Processors process the data to measure the output and store it to the memory.

D-A Converter – A digital-to-analog converter converts the digital data fed by the processor to analog data. · Actuator – An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

CHAPTER-2

LITERATURE AND REVIEW

2.1 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-2.1 Manual wood cradle



Figure-2.2 Cloth cradle

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.

2.2 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 is the reason why baby feels comfortable whenever the cradle swings.

2.3 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 starts swings. It has approx. six times per minute. It has wet sensor to show 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.

2.4 SMART BABY CRADLE BENEFIT

The requirement of automatic intelligent baby cradle is day by day increasing. Especially in metropolitan cities. The benefits of Automatic cradle are:

1. 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.
2. 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.

3. The one of the most benefit of this cradle is we can use cradle as a biomedical product in the hospital. Hospitals 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.

CHAPTER 3

AIM AND SCOPE

3.1 AIM

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 need to develop something unique that can help Parents to have a continuous surveillance on the Baby can notify about the same. Thus, we have produced an idea to design a Smart Cradle System using IOT which will help the Parents to monitor their child even if they are away from home and detect every activity of the Baby.

3.2 EXISTING SYSTEM

A Cradle that should be controllable by a smart phone, as well as send data to it, such as video/audio stream. It should have an automatic way to comfort the baby if the parent can't get to the baby right away. After coming up with a couple of features. They have used a Micro-controller, Wi-Fi module shield, Router, Stepper motor, Speaker, mic. The drawbacks of this paper are Baby's curiousness: Beside the risk of electrical shock, the components may fall off or be broken by the baby and the baby might even try to bite or eat the parts. Parents' worries: Parents consider the safety issues much more than the features products.

3.3 PROPOSED SYSTEM

The proposed prototype of smart baby cradle will monitor the activities of the infant. The cradle has motor which will rotate the mobile toy. The smart baby cradle has noise detection which will sense the noise when the baby is crying or making loud noise. A servo motor will rotate (swing) the cradle up to an angle that is safe when infant is inside the cradle. A GSM module to communicate with a remote device that is operated by parents. And an Arduino microcontroller to control and monitor the activities of the cradle. Also whenever the wet is detected it gives an buzzer alert and also sends an SMS alert to the parents.

3.4 HARDWARE REQUIREMENTS:

- ARDUINO UNO
- SERVO MOTOR
- WET SENSOR
- BUZZER
- GSM MODULE

3.5 SOFTWARE REQUIREMENTS:

- ARDUINO IDE
- EMBEDDED C

CHAPTER-4

EXPERIMENTAL OR MATERIALS AND METHODS

4.1 ARDUINO UNO

The UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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 4.1 Arduino

There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common

versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

4.1.1 ARDUINO BOARD

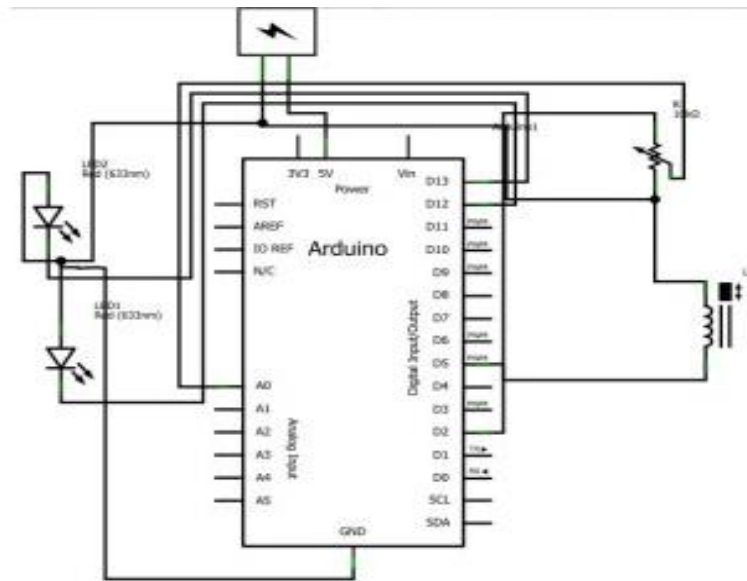


Figure 4.2 Arduino Uno with Digital input/Output

There are various types of Arduino boards in which many of them were third-party compatible versions. The most official versions available are the Arduino Uno R3 and the Arduino Nano V3. Both of these run a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM 14 digital I/O and six analogue I/O and the 32KB will not sound like as if running Windows. Arduino projects can be stand-alone or they can communicate with software on running on a computer. For e.g. Flash, Processing, Max/MSP). The board is clocked by a 16 MHz ceramic resonator and has a USB connection for power and communication. You can easily add micro SD/SD card storage for bigger tasks.

4.1.2 FEATURES OF ARDUINO:

- It is an easy USB interface. This allows interface with USB as this is like a serial device.
- The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.
- It is easy-to-find the microcontroller brain which is the ATmega328 chip. It has more number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep modes.



Figure 4.3 Pin Diagram of Arduino Uno

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware.

4.2 RAINDROP SENSOR:

Raindrop Sensor is a tool used for sensing rain. It consists of two modules, a rain board that detects the rain and a control module, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems.

4.2.1 RAINDROP SENSOR FEATURES:

Working voltage 5V

Output format: Digital switching output (0 and 1), and analog voltage output AO

Potentiometer adjust the sensitivity

Uses a wide voltage LM393 comparator

Comparator output signal clean waveform is good, driving ability, over 15mA

Anti-oxidation, anti-conductivity, with long use time

With bolt holes for easy installation

Small board PCB size: 3.2cm x 1.4cm

How to use Raindrop sensor:

Interfacing the raindrop sensor with a microcontroller like 8051, Arduino, or PIC is simple. The rain board module is connected with the control module of the raindrop sensor as shown in the below diagram.

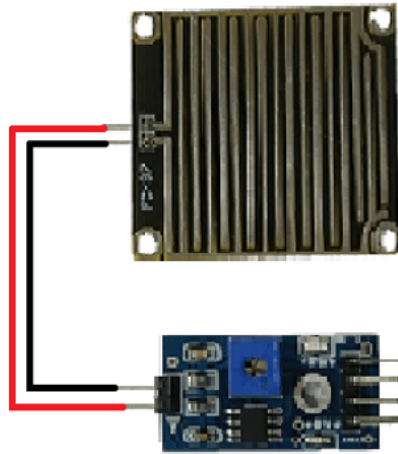


Figure 4.4 Raindrop Sensor

The control module of the raindrop sensor has 4 outputs. VCC is connected to a 5V supply. The GND pin of the module is connected to the ground. The D0 pin is connected to the digital pin of the microcontroller for digital output or the analog pin can be used. To use the analog output, the A0 pin can be connected to the ADC pin of a microcontroller. In the case of Arduino, it has 6 ADC pins, so we can use any of the 6 pins directly without using an ADC converter. The sensor module consists of a potentiometer, LN393 comparator, LEDs, capacitors and resistors. The pinout image above shows the components of the control module. The rain board module consists of copper tracks, which act as a variable resistor. Its resistance varies with respect to the wetness on the rain board. The below fig shows the rain board module.

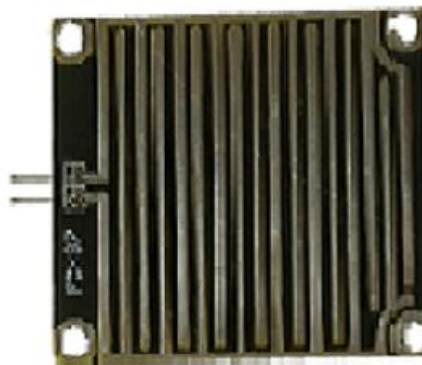


Figure 4.5 Rain Board Modules

The circuit diagram of a raindrop sensor module is given below.

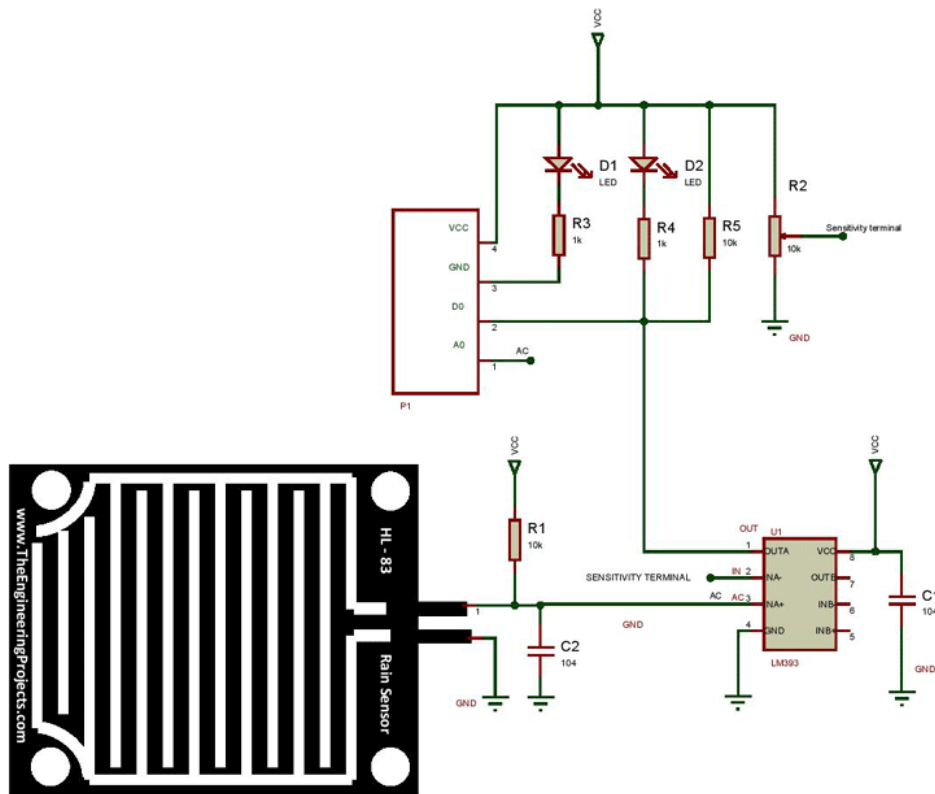


Figure 4.6 Raindrop Sensor Module Circuit Diagram

As shown in the above figure, the R1 resistor and the rain board module will act as a voltage divider. Capacitors C1 and C2 are used as a biasing element. The input for the Non-inverting terminal is taken from the connection point of the R1, and rain board module. Another point is taken from this connection and connected to the A0 terminal of the control module.

The input to the inverting terminal of the LM393 is taken from the potentiometer (R2). The R2 resistor acts as a voltage divider, and by varying R2 we can vary the input voltage to the inverting terminal, which in turn affects the sensitivity of the control module. The connections are shown in the above fig. The resistors R3 and R4 will act as current limiting resistors, while resistor R5 will act as a pull-up resistor to keep the bus in a high state when not in use.

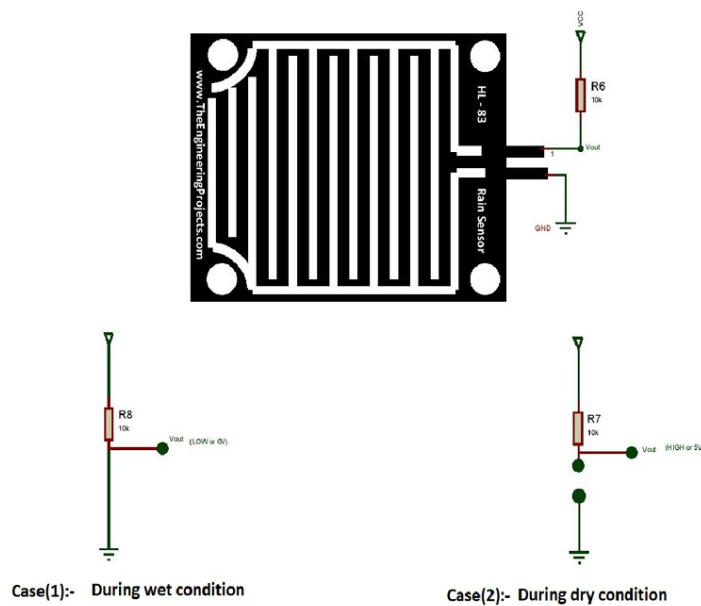


Figure 4.7 Working of Rain Sensor:

4.2.2 RAINDROP SENSOR WORKING

When the A0 pin is connected to the microcontroller, an additional analog to digital converter (ADC) circuit is used. In the case of Arduino, it consists of 6 ADC pins, which can be directly used for calculation purposes.

Applications of Rain sensor:

- Automatic windshield wipers
- Smart Agriculture
- Home-Automation

4.3 SOUND 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.

4.3.1 Sound Sensor Pin Configuration

This sensor includes three pins which include the following.



Figure 4.8 Sound-sensor-module

- Pin1 (VCC): 3.3V DC to 5V DC
- Pin2 (GND): This is a ground pin
- Pin3 (DO): This is an output pin

4.3.2 Working Principle

The working principle of this sensor is related to human ears. Because human ear includes a diaphragm and the main function of this diaphragm is, it uses the vibrations and changes into signals. Whereas in this sensor, it uses a microphone and the main function of this is, it uses the vibrations and changes into current otherwise voltage.

Generally, it includes a diaphragm which is designed with magnets that are twisted with metal wire. When sound signals hit the diaphragm, then magnets within the sensor vibrates & simultaneously current can be stimulated from the coils.

4.3.3 Features

The features of the sound sensor include the following

- These sensors are very simple to use
- It gives analog o/p signal
- Simply incorporates using logic modules on the input area

4.3.4 Sound Detection Sensor Module Pin Configuration

Pin Name	Description
VCC	The VCC pin powers the module, typically with +5V
GND	Power Supply Ground
DO	Digital Output Pin. Directly connected to digital pin of Microcontroller
AO	Analog Output Pin. Directly connected to an analog pin of Microcontroller

4.3.5 Specifications

The specifications of the sound sensor include the following

- The range of operating voltage is $3\frac{3}{5}$ V
- The operating current is 4~5 mA
- The voltage Gain 26 dB ((V=6V, f=1kHz)
- The sensitivity of the microphone (1kHz) is 52 to 48 dB
- The impedance of the microphone is 2.2k Ohm
- The frequency of m microphone is 16 to 20 kHz
- The signal to noise ratio is 54 Db

4.3.6 Applications

The applications of the sound sensor include the following.

- This sensor can be used to build various electronic projects with the help of an Arduino board. For instance, this project uses a grove sensor, which fundamentally gives your Arduino's ears. In this project, a microphone can be attached to an analog pin of the board. This can be used to notice the noise level within the nearby surroundings.
- The grove sensors support platforms like Arduino, Raspberry Pi, Beagle Bone Wio, and LinkIt ONE. This sensor plays an essential role while activating the light in your office or house by detecting a precise whistle or clap sound.

Some more applications of this sensor include the following.

- Security system for Office or Home
- Spy Circuit
- Home Automation
- Robotics
- Smart Phones
- Ambient sound recognition
- Audio amplifier
- Sound level recognition (not capable to obtain precise dB value)

4.4 SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term *servomotor* is often used to refer to a motor suitable for use in a control system.

Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

4.4.1 Mechanism

A servomotor is a closed-loop servomechanism that uses position feedback to

control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

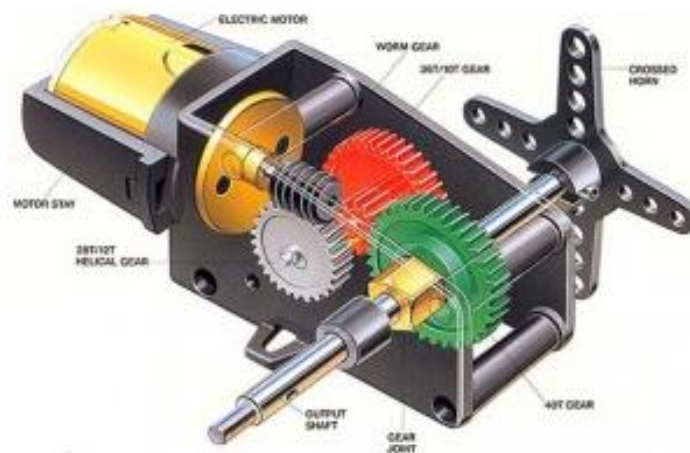


Figure 4.9 Servo Motor

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models.

More sophisticated servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed. Both of these enhancements, usually in combination with a PID control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting

The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device and a control circuit. The DC motor is connected with a gear mechanism which provides feedback to a position sensor

which is mostly a potentiometer. From the gear box, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas for high power servos, the gear is made up of metal.

A servo motor consists of three wires- a black wire connected to ground, a white/yellow wire connected to control unit and a red wire connected to power supply.



Figure 4.10 Function of servo motor

The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position.

It uses the position sensing device to figure out the rotational position of the shaft, so it knows which way the motor must turn to move the shaft to the instructed

position. The shaft commonly does not rotate freely around similar to a DC motor, however rather can just turn 200 degrees.

Controlling a Servo Motor:

A servo motor is controlled by controlling its position using Pulse Width Modulation Technique. The width of the pulse applied to the motor is varied and send for a fixed amount of time.

The pulse width determines the angular position of the servo motor. For example a pulse width of 1 ms causes an angular position of 0 degrees, whereas a pulse width of 2 ms causes an angular width of 180 degrees.

Advantages:

- If a heavy load is placed on the motor, the driver will increase the current to the motor coil as it attempts to rotate the motor. Basically, there is no out-of-step condition.
- High-speed operation is possible.

4.4.2 DC Servo Motor

The motor which is used as a DC servo motor generally have a separate DC source in the field of winding & armature winding. The control can be achieved either by controlling the armature current or field current. Field control includes some particular advantages over armature control. In the same way armature control includes some advantages over field control. Based on the applications the control should be applied to the DC servo motor. DC servo motor provides very accurate and also fast respond to start or stop command signals due to the low armature inductive reactance. DC servo motors are used in similar equipment and computerized numerically controlled machines.



Figure 4.11 DC Servo Motor

4.4.3 AC Servo Motor

AC servo motor is an AC motor that includes encoder is used with controllers for giving closed loop control and feedback. This motor can be placed to high accuracy and also controlled precisely as compulsory for the applications. Frequently these motors have higher designs of tolerance or better bearings and some simple designs also use higher voltages in order to accomplish greater torque. motor mainly involve in automation, robotics, CNC machinery, and other applications a high level of precision and needful versatility.



Figure 4.12 AC Servo Motor

Positional Rotation Servo Motor

Positional rotation servo motor is a most common type of servo motor. The shaft's o/p rotates in about 180°. It includes physical stops located in the gear mechanism to stop turning outside these limits to guard the rotation sensor. These common

servos involve in radio-controlled water, radio-controlled cars, aircraft, robots, toys and many other applications.

Continuous Rotation Servo Motor

Continuous rotation servo motor is quite related to the common positional rotation servo motor, but it can go in any direction indefinitely. The control signal, rather than set the static position of the servo, is understood as the speed and direction of rotation. The range of potential commands sources the servo to rotate clockwise or anticlockwise as preferred, at changing speed, depending on the command signal. This type of motor is used in a radar dish if you are riding one on a robot or you can use one as a drive motor on a mobile robot.



Figure 4.13 Continuous Rotation Servo Motor

Linear Servo Motor

Linear servo motor is also similar the positional rotation servo motor is discussed above, but with an extra gear to alter the o/p from circular to back-and-forth. These servo motors are not simple to find, but sometimes you can find them at hobby stores where they are used as actuators in higher model airplanes.



Figure 4.14 Linear Servo Motor

Servo Motor Working

A unique design for servo motors is proposed in controlling the robotics and for control applications. They are basically used to adjust the speed control at high torques and accurate positioning. Parts required are motor position sensor and a highly developed controller. These motors can be categorized according to the servo motor controlled by servomechanism. If DC motor is controlled using this mechanism, then it is named as a DC servo motor. Servo motors are available in power ratings from fraction of a watt to 100 watts. The rotor of a servo motor is designed longer in length and smaller in diameter so that it has low inertia. To know more about this, please follow the link: [Servo motor working principle and interfacing with 8051 microcontrollers](#)



4.5 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers

include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Figure 4.15 Buzzer

4.5.1 TYPES

Electromechanical

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

Mechanical

A joy buzzer is an example of a purely mechanical buzzer and they require drivers. Other examples of them are doorbells.



Figure 4.16 Piezoelectric

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

A piezoelectric buzzer/beeper also depends on acoustic cavity resonance or Helmholtz resonance to produce an audible beep

4.5.2 APPLICATIONS

While technological advancements have caused buzzers to be impractical and undesirable, there are still instances in which buzzers and similar circuits may be used. Present day applications include:

- Novelty uses
- Judging panels
- Educational purposes
- Annunciator panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms
- Joy buzzer (mechanical buzzer used for prank)

4.6 SIMPLE PIEZO BUZZER CIRCUIT DIAGRAM

Piezo buzzers are one of the most common buzzers available around, they got their name from the piezoelectric material used as the active element.

These buzzers are usually driven at a relatively higher voltage but low current, consumes a little power, but still capable of producing very high sound.

The Piezo element must be a three terminal one, like in the picture.

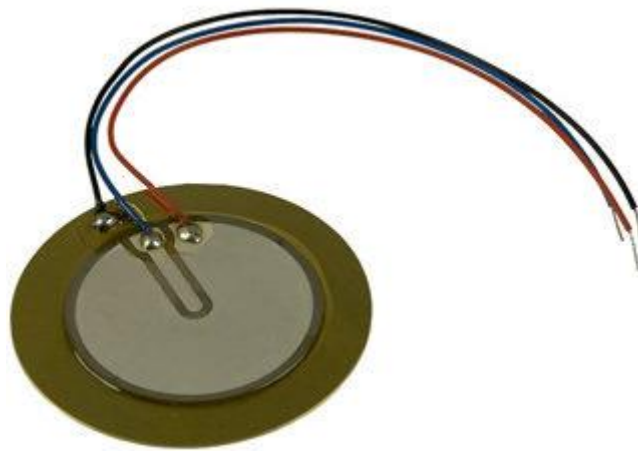


Figure 4.17 Three terminal Piezo element

The blue wire is connected to feedback (**F**) terminal, red wire to the main (**M**) terminal and the black wire to the piezo element's ground (**G**) plate.

The inductor coil's value and shape is not crucial. You can use any coil from **1mH** to **10mH** or more, or even no measured value at all. I used a 40 turn coil on a small ferrite toroid in the final design.

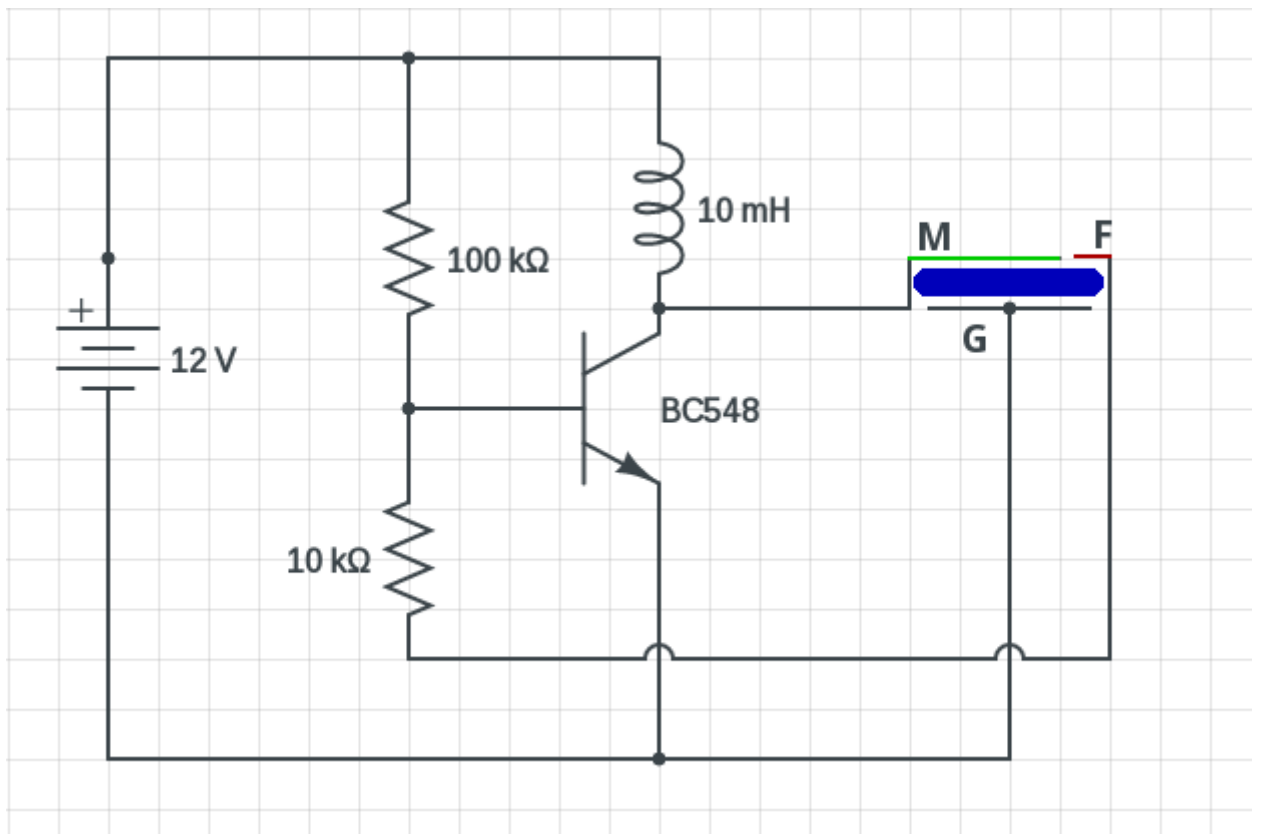


Figure 4.18 Circuit diagram and construction

Note the piezoelectric element's pin out, **M** is the main terminal, **F** is the feedback terminal and **G** is the ground plate.

The circuit is fairly simple, you can use a little piece of strip board to make it. As this piezo buzzer circuit uses very few components, so it also could be constructed by soldering the components to each other.

When a voltage is applied to the electrodes of the piezo element, they produce flex in either way. This flex force bends the ground plate up and down.

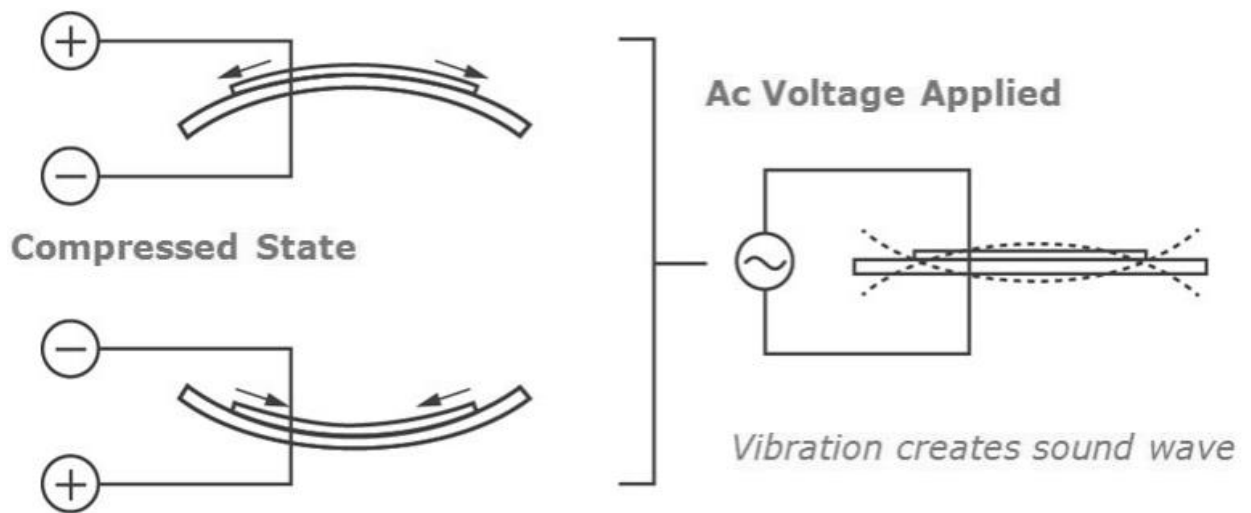


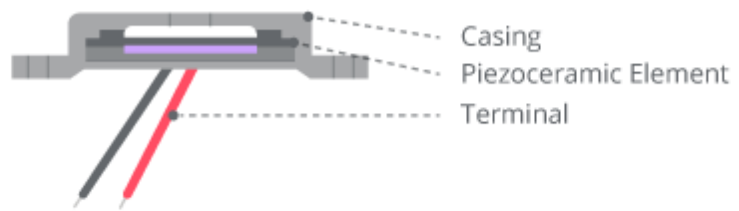
Figure 4.19 Working of the circuit

The exact opposite thing happens too, when a piezoelectric element is subjected to varying pressure, it produces voltage. As you've seen before, self-drive piezo buzzers are constructed with an extra electrically isolated feedback electrode. The voltage created by the flex force is available in the feedback terminal. The piezo buzzer is placed in a resonant cavity, there is a hole in the opposite side of the resonant cavity from where the buzzing sound comes out. The driver circuit and piezo buzzer co-operates soon between them and they start oscillating on the resonant frequency of the piezo buzzer.

4.6.1 Piezo Buzzer Characteristics

- Wide operating voltage: 3~250 V
- Lower current consumption: less than 30 mA higher rated frequency
- Larger footprint
- Higher sound pressure level

Transducer (without driving circuitry)



Indicator (with driving circuitry)

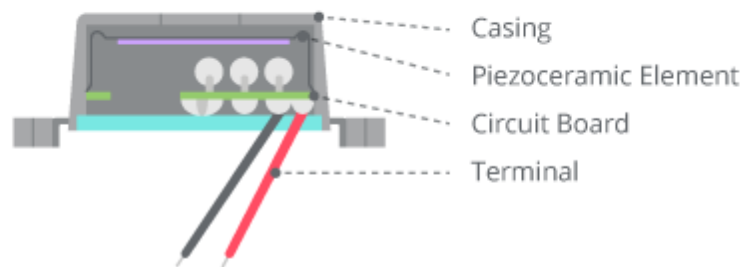


Figure 4.20 Structure of piezo buzzer

There are two types of piezo buzzers - transducers and indicators. Transducers consist of a casing, a piezoceramic element and a terminal. In order to operate a transducer, the user must send a square wave signal to the buzzer. Indicators consist of a casing, a piezoceramic element, a circuit board and a terminal. In order to operate an indicator, the user must send the buzzer a specified dc voltage.

4.7 GSM

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams

of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.



Figure 4.21 GSM Modem

There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

Time Division Multiple Access

TDMA technique relies on assigning different time slots to each user on the same frequency. It can easily adapt to data transmission and voice communication and can carry 64kbps to 120Mbps of data rate.

4.7.1 GSM Architecture

A GSM network consists of the following components:

- A Mobile Station: It is the mobile phone which consists of the transceiver, the display and the processor and is controlled by a SIM card operating over the network.
- Base Station Subsystem: It acts as an interface between the mobile station and the network subsystem. It consists of the Base Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the Base Station Controller which controls the Base Transceiver station and acts as an interface between the mobile station and mobile switching centre.

- **Network Subsystem:** It provides the basic network connection to the mobile stations. The basic part of the Network Subsystem is the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the Home Location Register and the Visitor Location Register which provides the call routing and roaming capabilities of GSM. It also contains the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.

4.7.2 Features of GSM Module:

- Improved spectrum efficiency
- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialing number (FDN)
- Real time clock with alarm management
- High-quality speech
- Uses encryption to make phone calls more secure
- Short message service (SMS)

The security strategies standardized for the GSM system make it the most secure telecommunications standard currently accessible. Although the confidentiality of a call and secrecy of the GSM subscriber is just ensured on the radio channel, this is a major step in achieving end-to- end security.

4.7.3 GSM Modem

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

A GSM modem can also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer.

GSM modem is usually preferable to a GSM mobile phone. The GSM modem has wide range of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging.

4.7.4 Working of GSM Module:

From the below circuit, a GSM modem duly interfaced to the MC through the level shifter IC Max232. The SIM card mounted GSM modem upon receiving digit command by SMS from any cell phone send that data to the MC through serial communication. While the program is executed, the GSM modem receives command 'STOP' to develop an output at the MC, the contact point of which are used to disable the ignition switch. The command so sent by the user is based on an intimation received by him through the GSM modem 'ALERT' a programmed message only if the input is driven low. The complete operation is displayed over 16×2 LCD display.

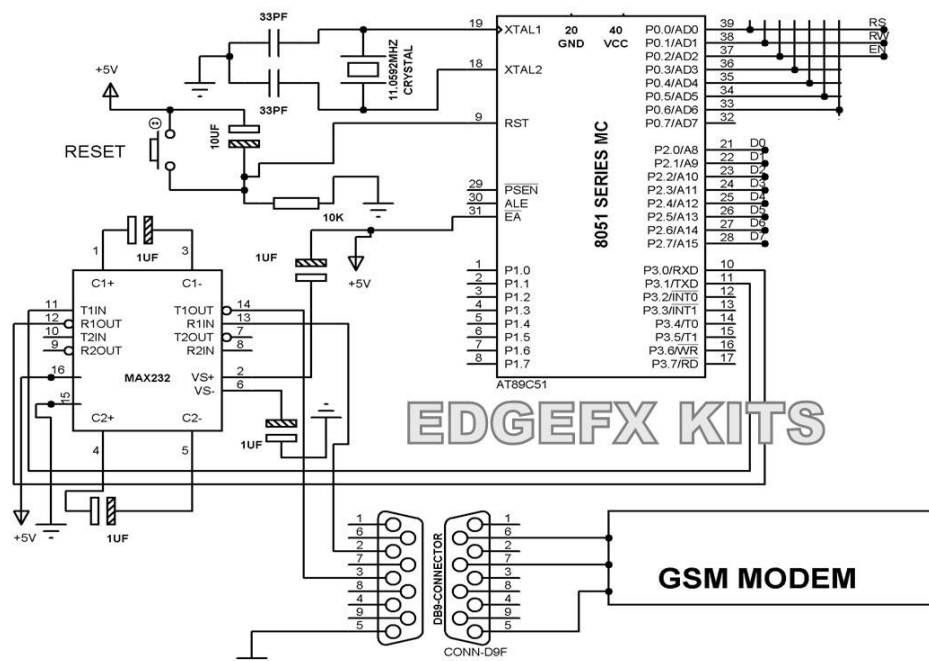


Figure 4.22 GMS Modem Circuit

4.7.5 Intelligent GSM Device for Automation and Security

In these days, the GSM mobile terminal has become one of the items that are constantly with us. Just like our wallet/purse, keys or watch, the GSM mobile terminal provides us a communication channel that enables us to communicate

with the world. The requirement for a person to be reachable or to call anyone at any time is very appealing.

In this project, as the name says project is based on GSM network technology for transmission of SMS from sender to receiver. SMS sending and receiving is used for ubiquitous access of appliances and allowing breach control at home. The system proposes two sub-systems. Appliance control subsystem enables the user to control home appliances remotely and the security alert subsystem gives the automatic security monitoring.

The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliance according to the user's needs and requirements. The second aspect is that of security alert which is achieved in a way that on the detection of intrusion, the system allows automatic generation of SMS thus alerting the user against security risk.

CHAPTER 5

RESULTS AND DISCUSSION, PERFORMANCE ANALYSIS

5.1 ARDUINO IDE:

Programming the Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials. The ATmega328 on the Arduino Uno comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU boot loader). See this user-contributed tutorial for more information. Automatic (Software) Reset Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer.

One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 Nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by

simply pressing the upload button in the Arduino environment. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data. The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

5.2 EMBEDDED C:

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all-device working is based on microcontroller that are programmed by embedded C.

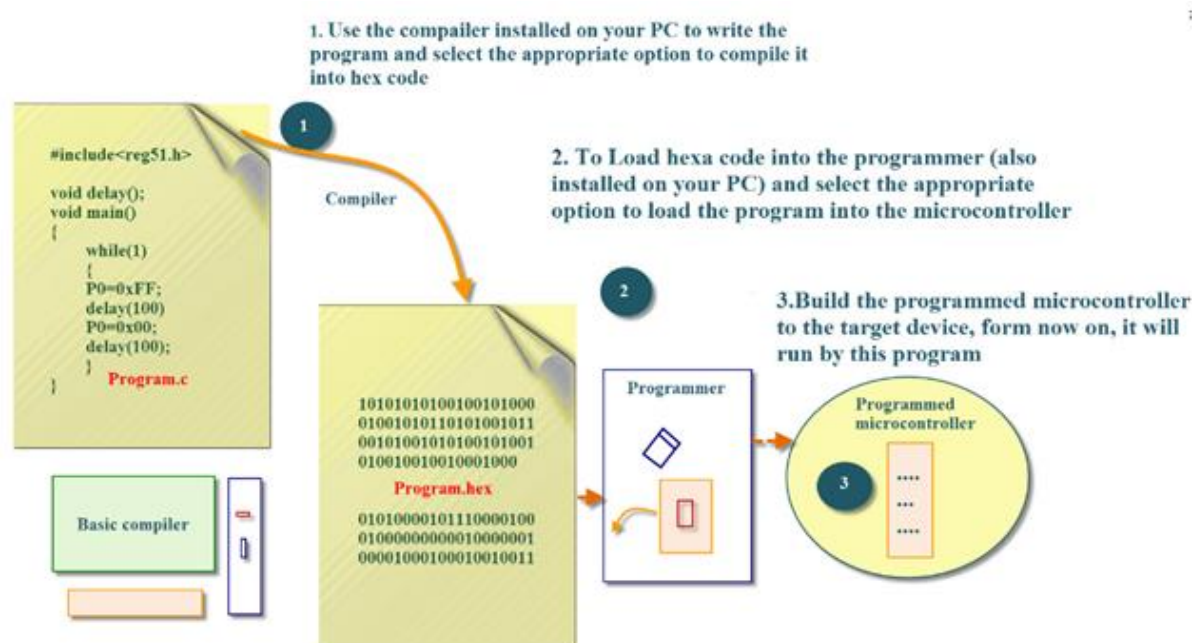


Figure 5.1 Embedded C code

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

Function is a collection of statements that is used for performing a specific task and a collection of one or more functions is called a programming language.

Most consumers are familiar with application software that provides functionality on a computer. Embedded software however is often less visible, but no less complicated. Unlike application software, embedded software has fixed hardware requirements and capabilities, and addition of third-party hardware or software is strictly controlled.

Embedded software needs to include all needed device drivers at manufacturing time, and the device drivers are written for the specific hardware. The software is highly dependent on the CPU and specific chips chosen. Most embedded software engineers have at least a passing knowledge of reading schematics, and reading data sheets for components to determine usage of registers and communication system. Conversion between decimal, hexadecimal and binary is useful as well as using bit manipulation.

Web applications are rarely used, although XML files and other output may be passed to a computer for display. File systems with folders are typically absent as are SQL databases.

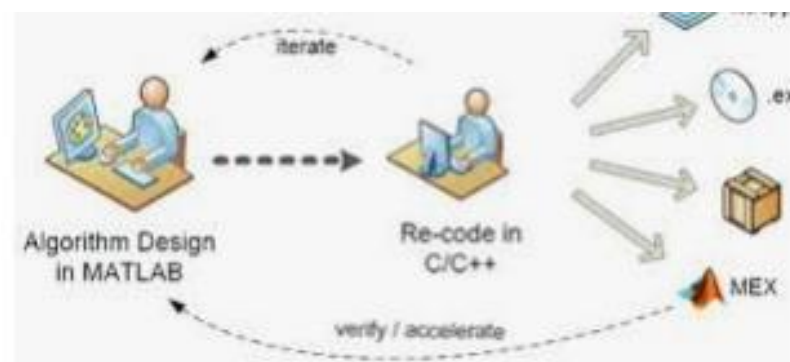
Software development requires use of a cross compiler, which runs on a computer but produces executable code for the target device. Debugging requires use of an in-circuit emulator, JTAG or SWD. Software developers often have access to the complete kernel (OS) source code.

Size of the storage memory and RAM can vary significantly. Some systems run in 16 KB of Flash and 4 KB of RAM with a CPU operating at 8 MHz, other systems can rival contemporary computers. These space requirements lead to more work being done in C or embedded C++, instead of C++. Interpreted languages like BASIC (while e.g. Parallax Propeller can use compiled BASIC) and Java (Java ME Embedded 8.3 is available for e.g. ARM Cortex-M4, Cortex-M7 microcontrollers and older ARM11 used in Raspberry Pi and Intel Galileo Gen. 2) are not commonly used; while an implementation of the interpreted Python 3 language – Micro Python – is however available expressly for microcontroller use, e.g. 32-bit ARM-based (such as BBC micro: bit) and 16-bit PIC microcontrollers.

Communications between processors and between one processor and other components are essential. Besides direct memory addressing, common protocols include I²C, SPI, serial ports, and USB.

Communications protocols designed for use in embedded systems are available as closed source from companies including InterNiche Technologies and CMX Systems. Open-source protocols stem from uIP, lwip, and others

- This program explains how to use structure within structure in C using normal variable. “student_college_detail” structure is declared inside “student_detail” structure in this program. Both structure variables Please note that members of “student_college_detail” structure are accessed by 2 dot(.) operator and members of “student” are normal structure variables.
- “_detail” structure are accessed by single dot(.) operator.



Embedded C Program with Examples ...

Figure 5.2 Embedded C program with examples

A Keyword is a special word with a special meaning to the compiler (a C Compiler for example, is a software that is used to convert program written in C to Machine Code). For example, if we take the Keil's Cx51 Compiler (a popular C Compiler for 8051 based Microcontrollers) the following are some of the keywords:

- bit
- sbit
- sfr
- small
- large

These are few of the many keywords associated with the Cx51 C Compiler along with the standard C Keywords.

CHAPTER-6

6.1 CONCLUSION

The proposed smart cradle concept is a less priced and easier-to-use technology. It has the potential to increase the quality of the newborn care system. This approach will provide parents peace of mind that their infants are being well cared for. The continual capture and the proposed smart cradle notion result in a less expensive and easier-to-use solution. It has the potential to increase the quality of the newborn care system. This approach will provide parents peace of mind that their infants are being well cared for. The continual monitoring of the baby's numerous biological indicators assists the mother in understanding the baby's internal health state. Because GSM technology is employed, the user may communicate over a greater distance. It is a convenient device for remotely monitoring the baby's health care.

REFERENCE

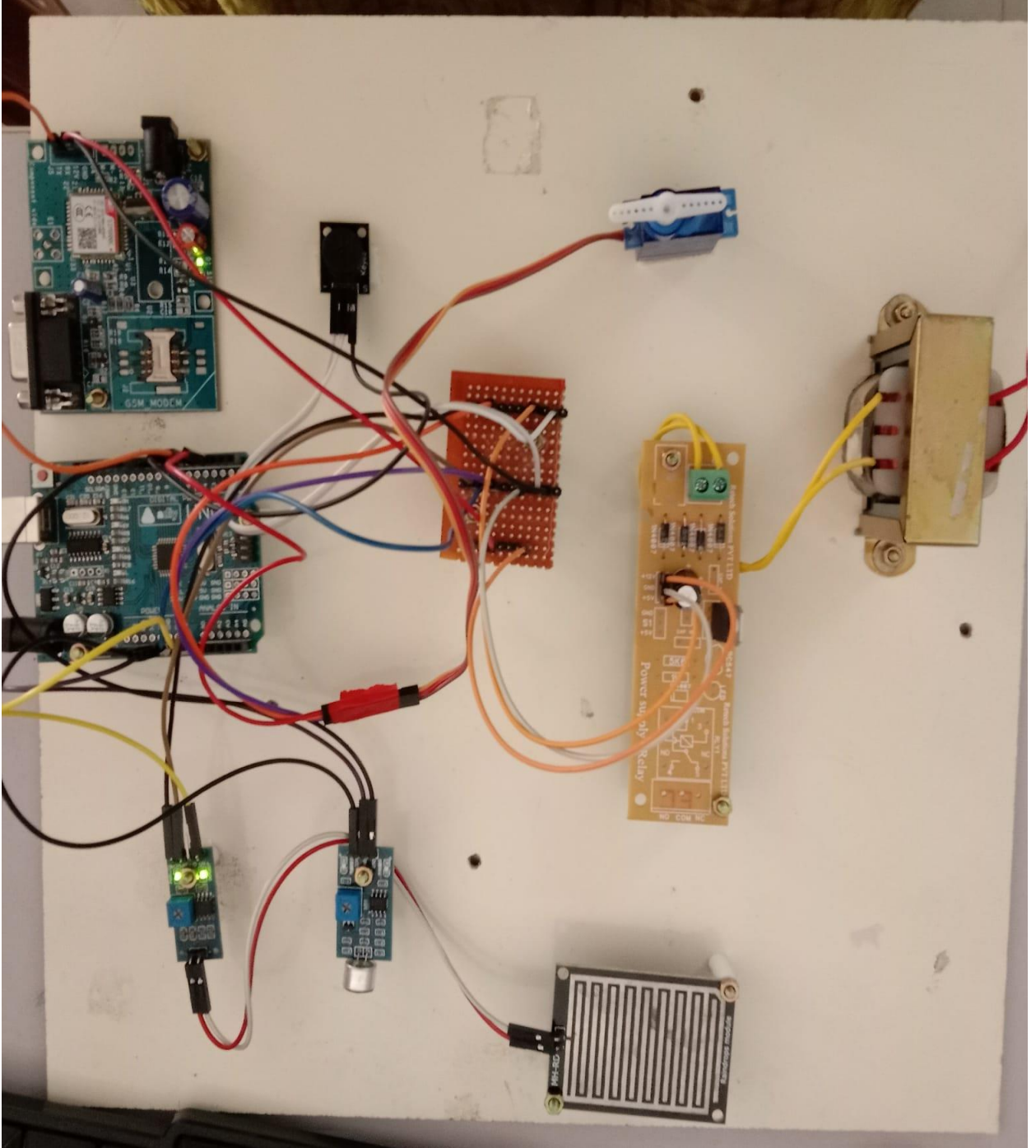
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APPENDIX

SNAPSHOTS OF THE OUTPUT



SOURCE CODE :

```
#include <Servo.h>
int servoPin = 3;
Servo myservo;
#include <SoftwareSerial.h>
SoftwareSerial mySerial(4, 5);
int wet_sensor = A0;
int Sound_sensor = 9;
int pos = 0;
int buzzer = 7;
int led = 6;
void setup() {
    // put your setup code here, to run once:
    Serial.begin(9600);
    mySerial.begin(9600);
    pinMode(wet_sensor, INPUT);
    pinMode(Sound_sensor, INPUT);
    pinMode(buzzer, OUTPUT);
    pinMode(led, OUTPUT);
    myservo.attach(servoPin);
}

void loop() {
    // put your main code here, to run repeatedly:
    int a = analogRead(wet_sensor);
    Serial.print("WET RANGE = ");
    Serial.println(a);
    if (a < 500) {
        tone(buzzer, 500, 2000);
        mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode
        delay(1000); // Delay of 1000 milli seconds or 1 second
        mySerial.println("AT+CMGS="+919092098217+"\r"); // Replace x with mobile
        number
    }
}
```

```

    delay(1000);
    mySerial.println("Urine Detected");// The SMS text you want to send
    delay(100);
    mySerial.println((char)26);// ASCII code of CTRL+Z
    delay(1000);
    Serial.println("MESSAGE SEND WET");
}
int b = digitalRead(Sound_sensor);
Serial.print("SOUND = ");
Serial.println(b);
if (b ==0) {
    for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
        // in steps of 1 degree
        myservo.write(pos);          // tell servo to go to position in variable 'pos'
        delay(30);                  // waits 15ms for the servo to reach the position
    }
    for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
        myservo.write(pos);          // tell servo to go to position in variable 'pos'
        delay(30);                  // waits 15ms for the servo to reach the position
    }
    mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode
    delay(1000); // Delay of 1000 milli seconds or 1 second
    mySerial.println("AT+CMGS=\"" +919092098217+"\r"); // Replace x with mobile
number
    delay(1000);
    mySerial.println("Baby is crying");// The SMS text you want to send
    delay(100);
    mySerial.println((char)26);// ASCII code of CTRL+Z
    delay(1000);
    Serial.println("MESSAGE SEND CRYING");
    noTone(buzzer);
}
}

```