SONOPANT DANDEKAR ARTS, V.S. APTE COMMERCE
AND M.H. MEHTA SCIENCE COLLEGE, PALGHAR

Department of Physics

# PROJECT REPORT

## Master of Science Physics

**Academic Year 2022-2023**


Prepared by

**Department of Physics**

**Sonopant Dandekar Arts, V.S. Apte Commerce and**
**M.H. Mehta Science College, Palghar**

# INDEX

Sonopant Dandekar Shikshan Mandali's
Sonopant Dandekar Arts,
V. S. Apte Commerce &
M. H. Mehta Science College, Palghar
Estb.: 14 August 1968
Dr. Kiran Save, Principal

Kharekuran Road, Palghar (W), Tal. & Dist. Palghar,
Maharashtra - 401 404, INDIA
Tel. : +91 - 2525 - 252163
Principal : +91 - 2525 - 252317
Email : sdsmcollege@yahoo.com
Web. : www.sdsmcollege.com

Ref No.:

Date : 15/03/2023

## Department of Physics

# NOTICE

## M.Sc – II (Physics) 2022-23

### Project submission SEM – IV

All Master of Science Physics Part-II Physics students are hereby informed that submit the submission of your Master of Science project Soft Copy and Black-Book on and before dated - 26/03/2023. The guidelines for the project report format have been provided previously.

**Co-Ordinator**
**Department of Physics**

PRINCIPAL **Principal**
Sonopant Dandekar Arts College,
V.S. Apte Commerce College &
M.H. Mehta Science College
PALGHAR (W.R.)
Dist. Palghar, Pin-401404

**UNIVERSITY OF MUMBAI**

No. UG/135 of 2018-19

**CIRCULAR:-**

Attention of the Principals of the affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/88 of 2017-18, dated 21st July, 2017, relating to syllabus as per the (CBCS) for (Sem. I to IV) of the M.Sc. Programme in the Course of Physics.

They are hereby informed that the recommendations made by the Board of Studies in Physics at its meeting held on 23rd July, 2018 have been accepted by the Academic Council at its meeting held on 8th September, 2018 **vide** item No. 4.12 and that in accordance therewith, the revised syllabus as per the (CBCS) for the M.Sc. in Physics (Sem. III & IV) has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
12th December, 2018

(Prof. Sunil Bhirud)
I/c. REGISTRAR

To

The Principals of the affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No.UG/334of 2017-18 dated 9th January, 2018.)

**A.C/4.12/08/09/2018**

**********

No. UG/135 -A of 2018 MUMBAI-400 032 12th December, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Physics,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-ordinator, University Computerization Centre,

(Prof. Sunil Bhirud)
I/c. REGISTRAR

**AC. - 08/09/2018**
**Item No. _____**

# University of Mumbai


Syllabus for **Semesters - III & IV**

## Program - M. Sc.

## Course -Physics

(Choice Based Credit System)

(With effect from the academic year 2018-19)

**Course Structure & Distribution of Credits.**

M. Sc. in Physics Program consists of total 16 theory courses, total 6 practical lab courses and 2 projects spread over four semesters. Twelve theory courses and four practical lab course are common and compulsory for all the students. Remaining four theory courses can be chosen from the list of elective courses offered by the institute. Two Lab courses can be chosen from the elective lab courses offered by the institute. Each theory course will be of 4 (four) credits, each practical lab course will be of 4 (four) credits and each project will be of 4 (four) credits. A project can be on theoretical physics, experimental physics, applied physics, development physics, computational physics or industrial product development. A student earns 24 (twenty four) credits per semester and total 96 (ninety six) credits in four semesters. The course structure is as follows,

**Theory Courses**

| | Paper-1 | Paper-2 | Paper-3 | Paper-4 |
|---|---|---|---|---|
| Semester-I | Mathematical Methods | Classical Mechanics | Quantum Mechanics I | Solid State Physics |
| Semester-II | Advanced Electronics | Electrodynamics | Quantum Mechanics-II | Solid State Devices |
| Semester-III | Statistical Mechanics | Nuclear Physics | Elective Course -1 | Elective Course -2 |
| Semester-IV | Experimental Physics | Atomic and Molecular Physics | Elective Course -3 | Elective Course -4 |

**Practical Lab Courses**

| | | |
|---|---|---|
| Semester-I | Lab Course -1 | Lab Course -2 |
| Semester-II | Lab Course -3 | Lab Course -4 |
| Semester-III | Project -1 | Elective Lab Course-1 |
| Semester-IV | Project -2 | Elective Lab Course-2 |

The elective theory courses offered by PG Centers will be from the following list:

1. Nuclear Structure
2. Experimental Techniques in Nuclear Physics
3. Electronic structure of solids
4. Surfaces and Thin Films
5. Microcontrollers and Interfacing

6. Embedded systems and RTOS
7. Signal Modulation and Transmission Techniques
8. Microwave Electronics, Radar and Optical Fiber Communication
9. Semiconductor Physics
10. Thin Film Physics and Techniques
11. Fundamentals of Materials Science
12. Nanoscience & Nanotechnology
13. Astronomy and Space Physics
14. Laser Physics
15. Group Theory
16. Applied Thermodynamics
17. QuantumField Theory
18. Nuclear Reactions
19. Particle Physics
20. Properties of Solids
21. Crystalline &Non-crystalline solids
22. Advanced Microprocessor and ARM-7
23. VHDL and communication Interface
24. Digital Communication Systems and Python Programming
25. Computer Networking
26. Physics of Semiconductor Devices
27. Semiconductor Technology
28. Materials and their applications
29. Energy Studies
30. Galactic & Extragalactic Astronomy
31. Plasma Physics
32. Liquid Crystals
33. Numerical Techniques
34. Polymer Physics
35. Non-linear Dynamics
36. Advanced Statistical Mechanics

Only some electives will be offered by each PG centre. Every year different electives may be offered depending on the availability of experts in PG centres.

**Semester III**

M.Sc. in Physics Program for Semester-III consists of four theory courses, one Practical Lab course and one Project course. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

| Theory Paper | Subject | Lectures(Hrs.) | Credits |
|---|---|---|---|
| **PSPH301** | Statistical Mechanics | 60 | 04 |
| **PSPH302** | Nuclear Physics | 60 | 04 |
| * | Elective Course | 60 | 04 |
| * | Elective Course | 60 | 04 |
| | **TOTAL** | **240** | **16** |

*: To be chosen from the list below with odd-even number combination. Odd numbered course will be paper-3 and even numbered course will be paper-4.

| **Theory Paper** | **Subjects** | **Lectures(Hrs.)** | Credits |
|---|---|---|---|
| **PSPHET301** | Nuclear Structures | 60 | 04 |
| **PSPHET302** | Nuclear Reactions | 60 | 04 |
| **PSPHET303** | Electronic Structures of Solids | 60 | 04 |
| **PSPHET304** | Surfaces and Thin Films | 60 | 04 |
| **PSPHET305** | Microcontrollers and Interfacing | 60 | 04 |
| **PSPHET306** | Embedded Systems and RTOS | 60 | 04 |
| **PSPHET307** | Signal Modulation and Transmission Techniques | 60 | 04 |
| **PSPHET308** | Microwave Electronics, Radar and Optical Fiber Communication | 60 | 04 |
| **PSPHET309** | Semiconductor Physics | 60 | 04 |
| **PSPHET310** | Thin Film Physics and Techniques | 60 | 04 |
| **PSPHET311** | Fundamentals of Material Science | 60 | 04 |
| **PSPHET312** | Nanoscience and nanotechnology | 60 | 04 |
| **PSPHET313** | Galactic and Extragalactic Astronomy | 60 | 04 |
| **PSPHET314** | Plasma Physics | 60 | 04 |
| **PSPHET315** | Group Theory | 60 | 04 |
| **PSPHET316** | Applied Thermodynamics | 60 | 04 |
| **PSPHET317** | Quantum Field Theory | 60 | 04 |

| | | | |
|---|---|---|---|
| **PSPHET318** | Non-linear Dynamics | 60 | 04 |

Project (1): 8 hours per week

| **Project** | Course | Total Project Period (Hrs) | Credits |
|---|---|---|---|
| **PSPHP301** | Project -3 | **120** | **04** |

Practical lab course (1): 8 hours per week

| **Practical Lab Course** | Course | Practical Lab Sessions (Hrs) | Credits |
|---|---|---|---|
| **PSPHPAP302** | **Advanced Physics Lab-1** | **120** | **04** |

**Semester IV**

M.Sc. in Physics Program for Semester-IV consists of four theory courses, one Practical Lab course and one Project course. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

| Theory Paper | Subject | Lectures(Hrs.) | Credits |
|---|---|---|---|
| **PSPH401** | Experimental Physics | 60 | 04 |
| **PSPH402** | Atomic and Molecular Physics | 60 | 04 |
| * | Elective Course | 60 | 04 |
| * | Elective Course | 60 | 04 |
| | **TOTAL** | **240** | **16** |

*: To be chosen from the list below with odd-even number combination. Odd numbered course will be paper-3 and even numbered course will be paper-4.

| **Theory Paper** | **Subjects** | **Lectures(Hrs.)** | Credits |
|---|---|---|---|
| **PSPHET401** | Experimental Techniques in Nuclear Physics | 60 | 04 |
| **PSPHET402** | Particle Physics | 60 | 04 |
| **PSPHET403** | Crystalline & Non-crystalline Solids | 60 | 04 |
| **PSPHET404** | Properties of Solids | 60 | 04 |
| **PSPHET405** | Advanced Microprocessor and ARM 7 | 60 | 04 |
| **PSPHET406** | VHDL and Communication Interface | 60 | 04 |
| **PSPHET407** | Digital Communication Systems and | 60 | 04 |

| | | | |
|---|---|---|---|
| | Python Programming | | |
| **PSPHET408** | Computer Networking | 60 | 04 |
| **PSPHET409** | Physics of Semiconductor Devices | 60 | 04 |
| **PSPHET410** | Semiconductor Technology | 60 | 04 |
| **PSPHET411** | Materials and their applications | 60 | 04 |
| **PSPHET412** | Energy Studies | 60 | 04 |
| **PSPHET413** | Astronomy and Space Physics | 60 | 04 |
| **PSPHET414** | LASER Physics | 60 | 04 |
| **PSPHET415** | Liquid Crystals | 60 | 04 |
| **PSPHET416** | Numerical Techniques | 60 | 04 |
| **PSPHET417** | Polymer Physics | 60 | 04 |
| **PSPHET418** | Advanced Statistical Mechanics | 60 | 04 |

Project (1): 8 hours per week

| **Project** | Course | Total Project Period (Hrs) | Credits |
|---|---|---|---|
| **PSPHP401** | Project -4 | **120** | **04** |

Practical lab course (1): 8 hours per week

| **Practical Lab Course** | Course | Practical Lab Sessions (Hrs) | Credits |
|---|---|---|---|
| **PSPHPAP402** | **Advanced Physics Lab-2** | **120** | **04** |

The candidate shall be awarded the degree of *Master of Science in Physics***(M. Sc. In Physics)** after completing the course and meeting all the evaluation criteria. The Elective Course titles will appear in the statement of marks. When the elective courses are chosen from a particular specialization, the statement of marks shall also carry the name of the specializations as stated below. Courses selected in third semester for a particular specialization are prerequisites for courses in fourth semester for that specialization.

| **No.** | **Group of Elective Courses Chosen** | **Name appearing in the Statement of Marks** | **Name appearing in the Degree Certificate** |
|---|---|---|---|
| 1 | PSPHET301,PSPHET302 PSPHET401,PSPHET402 | M.Sc. in Physics (Nuclear Physics) | M.Sc. in Physics |
| 2 | PSPHET303,PSPHET304 PSPHET403,PSPHET404 | M.Sc. in Physics (Solid State Physics) | M.Sc. in Physics |

| | | | |
|---|---|---|---|
| 3 | PSPHET305,PSPHET306<br>PSPHET405,PSPHET406 | M.Sc. in Physics<br>(Electronics-I) | M.Sc. in Physics |
| 4 | PSPHET307,PSPHET308<br>PSPHET407,PSPHET408 | M.Sc. in Physics<br>(Electronics-II) | M.Sc. in Physics |
| 5 | PSPHET309,PSPHET310<br>PSPHET409,PSPHET410 | M.Sc. in Physics<br>(Solid State Electronics) | M.Sc. in Physics |
| 6 | PSPHET311,PSPHET312<br>PSPHET411,PSPHET404 | M.Sc. in Physics<br>(Materials Science) | M.Sc. in Physics |
| 7 | PSPHET311,PSPHET316<br>PSPHET411,PSPHET412 | M.Sc. in Physics<br>(Materials for Energy Technology) | M.Sc. in Physics |
| 8 | Any other combination of courses | M.Sc. in Physics | M.Sc. in Physics |

**2. Scheme of Examination and Passing:**

1. This course will have 40% Term Work (TW) / Internal Assessment (IA) and 60% External Assessment (University written examination of 2.5 Hours duration for each course paper and practical examination of 4 Hours duration for each practical). All external examinations will be held at the end of each semester and will be conducted by the University as per the existing norms.
2. Term Work / Internal Assessment - IA (40%) and University examination (60%)- shall have separate heads of passing. For Theory courses, internal assessment shall carry 40 marks and Semester-end examination shall carry 60 marks for each Theory Course.
3. To pass, a student has to obtain minimum grade point Eor above separately in the IA and the external examination.
4. The University (external) examination for all Theory and Practical courses shall be conducted at the end of each Semester and the evaluation of Project course and Project Dissertation will be conducted at the end of the each Semester.
5. The candidates shall appear for external examination of 4 theory courses each carrying 60 marks of 2.5 hours duration and 2 practical courses(1 Practical Course and 1 Project Course in M.Sc. Part II) each carrying 100 marks at the end of each semester.
6. The candidate shall prepare and submit for practical examination a certified Journalbased on the practical course carried out under the guidance of a faculty member withminimum number of experiments as specified in the syllabus for each group.

7. The candidate shall submit a Project Report / Dissertation for the Project Course at the end of each semester as per the guidelines given on the last page (Page No. 86).

**3. Standard of Passing for University Examinations:**

As per ordinances and regulations prescribed by the University for semester based credit and grading system.

**4. Standard point scale for grading:**

| Marks | Grade Points | Grade | Performance |
|---|---|---|---|
| 80.00 and Above | 10 | O | Outstanding |
| 70 to 79.99 | 9 | A+ | Excellent |
| 60 to 69.99 | 8 | A | Very Good |
| 55 to 59.99 | 7 | B+ | Good |
| 50 to 54.99 | 6 | B | Above Average |
| 45 to 49.99 | 5 | C | Average |
| 40 to 44.99 | 4 | D | Pass |
| Less Than 40 | 1 | F | Fail |

**5. Grade Point Average (GPA) calculation:**

1. GPA is calculated at the end of each semester after grades have been processed and after any grades have been updated or changed. Individual assignments / quizzes / surprise tests / unit tests / tutorials / practicals / project / seminars etc. as prescribed by University are all based on the same criteria as given above. The teacher should convert his marking into the Quality-Points and Letter-Grade.
2. Performance of a student in a semester is indicated by a number called Semester Grade Point Average (SGPA). It is the weighted average of the grade points obtained in all the subjects registered by the students during the semester

$$SGPA = \frac{\sum_{i=1} C_i p_i}{\sum_{i=1} C_i}$$

$Ci$ = The number of credits earned in the $i^{th}$ course of a semester.

$p_i$ = Grade point earned in the $i^{th}$ course

$i = 1,2, \ldots . n$ represents number of courses for which the student is registered.

3. The Final gradewill be decided on the basis of Cumulative Grade Point Average (CGPA) which is weighted average of the grade points obtained in all the semesters registered by the learner.

$$CGPA = \frac{\sum_{j=1} C_j p_j}{\sum_{j=1} C_j}$$

$C_j$ = The number of credits earned in the $j^{th}$ course upto the semester for which the CGPA is calculated

$p_j$ = Grade point earned in the $j^{th}$ course*

$j = 1,2, \ldots . n$represents number of courses for which the student is registered up to the semester for which the CGPA is calculated

* : A letter Grade lower than E in a subject shall not be takeninto consideration for the calculation of CGPA

The CGPA is rounded upto the two decimal places.

**M.Sc. (Physics) Theory Courses**

**Semester –III**

**Semester-III : Paper-I:**

**Course no.: PSPH301: Statistical Mechanics (60 lectures, 4 credits)**

***Unit – I***

The Statistical Basis of Thermodynamics - The macroscopic and the microscopic states, contact between statistics and thermodynamics, the classical ideal gas, The entropy of mixing and the Gibbs paradox, the enumeration of the microstates

Elements of Ensemble Theory - Phase space of a classical system, Liouville's theorem and its consequences.

The microcanonical ensemble - Examples

Quantum states and the phase space

***Unit – II***

6. Analog and Digital Communication Systems by Martin S. Roden (5th ed., Shroff Publishers and Distributors Pvt. Ltd.).
7. Microwaves by K. C. Gupta (New Age International Ltd.).
8. Electronic Communications by Dennis Roddy and John Coolen (4th ed., Pearson Education).
9. Basic microwave techniques and laboratory manual by M. L. Sisodia and G. S. Raghuvanshi (Wiley Eastern Ltd. 1987.).
10. Electronic communication systems by George Kennedy and Bernard Davis (4th ed., Tata McGraw Hill Publishing Company Ltd., New Delhi).
11. Digital communication systems by Harold Kolimbiris (Pearson Education Asia).
12. Optical fiber communication by G. Keiser (3rd ed., McGraw Hill).
13. Digital signal processing demystified by James D. Broesch (Penram International Publications, India).
14. The indispensable PC hardware book - Hans-Peter Messmer, Addison Wesley (PEA).
15. Parallel port complete by Jan Axelson, (Penram International Publications, India).
16. Serial port complete by Jan Axelson, (Penram International Publications, India).
17. Innovative experiments using Phoenix by AjitkumarmIUACm New Delhi, India.

**Note:**

1. Journal should be certified by the laboratory in-charge only if the student performs satisfactorily the minimum number of experiments as stipulated above. Such students, who do not have certified journals, will not be allowed to appear for the practical examinations.

## M.Sc. (Physics) Projects

### Semesters III and IV

**Project evaluation guidelines**

Every student will have to complete one project each in Semester III and Semester IV with four credits (100 marks) each. Students can take one long project (especially for SSP/SSE/Material Sc/Nanotechnology/Nuclear Physics etc) or two short project (especially for EI /EII). However, for one long project

students have to submit two separate project reports / dissertation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester III and actual experimental work, results and analysis in semester IV with four credits each. Those who have opted for two separate projects will also have to submit two separate project reports at each examination. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipments etc.

Maximum three students can do a joint project. Each one of them will submit a separate project report with details/part only he/she has done. However he/she can in brief (in a page one or two) mention in Introduction section what other group members have done. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project. In case a student takes training in a research institute/training of handling sophisticate equipment, he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.
Each project will be of 100 marks with 50% by internal and 50% by external evaluation.

**The project report should be file bound/spiral bound/hard bound and should have following format**

- Title Page/Cover page
- Certificate endorsed by Project Supervisor and Head of Department
- Declaration
- Abstract of the project
- Table of Contents
- List of Figures
- List of Tables
- Chapters of Content –
- Introduction and Objectives of the project
- Experimental/Theoretical Methodology/Circuit/Model etc. details
- Results and Discussion if any
- Conclusions
- References

Sonopant Dandekar Shikshan Mandali's
Sonopant Dandekar Arts,
V. S. Apte Commerce &
M. H. Mehta Science College, Palghar
Estb.: 14 August 1968
Dr. Kiran Save, Principal

Kharekuran Road, Palghar (W), Tal. & Dist. Palghar,
Maharashtra - 401 404, INDIA
Tel. : +91 - 2525 - 252163
Principal : +91 - 2525 - 252317
Email : sdsmcollege@yahoo.com
Web. : www.sdsmcollege.com

Ref No.: Date :

# Department of Physics

## M.Sc. Physics Project 2022-23

| Sr. No. | Roll No. | Name of student | Title of project |
|---|---|---|---|
| 1 | 45001 | Ersha More | Air pollution detector using 8051 Microcontroller |
| 2 | 45004 | Archana Lahange | Air pollution detector using 8051 Microcontroller |
| 3 | 45008 | Mayur Govind | OTP based door lock system using Arduino |
| 4 | 45010 | Prajakta Karnik | OTP based door lock system using Arduino |
| 5 | 45009 | Rohini Taktode | Human following robot |
| 6 | 45005 | Vinod Govari | Microcontroller based water level detection and monitoring system |
| 7 | 45007 | Sandesh Bendaga | Microcontroller based water level detection and monitoring system |
| 8 | 45012 | Adesh Thakur | Microcontroller based water level detection and monitoring system |
| 9 | 45003 | Priya Patil | Automatic alarm buzzer during CNG gas leakage detection in vehicles |
| 10 | 45002 | Ashish Jha | Electric Harvesting: Towards Green Energy |
| 11 | 45006 | Grinabh Kadu | Electric Harvesting: Towards Green Energy |

# SONOPANT DANDEKAR ARTS, V.S.APTE COMMERCE AND M.H.MEHTA SCIENCE COLLEGE,

Palghar, Dist.- Palghar, Pin- 401 404.

## Department of Physics

## M.Sc. Physics Project 2022-23

| Sr. no | Roll no | Name of student | Title of project | Signature |
|---|---|---|---|---|
| 1 | 45001 | Ersha More | Air pollution detector using 8051 microcontroller | E. More |
| 2 | 45004 | Archana Lahange | Air pollution detector using 8051 microcontroller | Lahange |
| 3 | 45008 | Mayur Govind | OTP based door lock system using arduino | |
| 4 | 45010 | Prajakta karnik | OTP based door lock system using arduino | Prajakta. |
| 5 | 45009 | Rohini Taktode | Human following robot | Taktode |
| 6 | 45005 | Vinod Govari | Microcontroller based water level detection and monitoring system | |
| 7 | 45007 | Sandesh Bendaga | Microcontroller based water level detection and monitoring system | |
| 8 | 45012 | Adesh Thakur | Microcontroller based water level detection and monitoring system | |
| 9 | 45003 | Priya patil | Automatic alarm buzzer during CNG gas leakage detection in vehicles | P Patil |
| 10 | 45002 | Ashish Jha | Electric Harvesting :towards Green Energy | |
| 11 | 45006 | Grinabh Kadu | Electric Harvesting :towards Green Energy | |

**SONOPANT DANDEKAR ARTS V.S APTE COMMERCE AND M.HMEHTA SCIENCE COLLEGE PALGHAR DIST-POST-TAL-PALGHAR CODE:(02525)252163, PRIN: 252317 RESI: 252316**

**UNIVERSITY OF MUMBAI**

A PROJECT REPORT ON

# " PIEZO ELECTRIC HARVESTING: TOWARDS GREEN ENERGY "

SUBMITTED BY

NAME: - **AASHISH JAYGOVIND JHA**

SEAT NO: - **4140742**

UNDER THE GUIDANCE OF

**Dr SAPNA B. JADHAV**

**&**

**PROFESSOR UTKARSHA SAVE**

MASTER OF SCIENCE

PHYSICS

2022-2023

**SONOPANT DANDEKAR ARTS V.S APTE COMMERCE AND M.HMEHTA SCIENCE COLLEGE PALGHAR DIST-POST-TAL-PALGHAR CODE:(02525)252163, PRIN: 252317 RESI: 252316**

# DEPARTMENT OF PHYSICS

SEAT NO- **4140742**

## CERTIFICATE

This is to certify that **AASHISH JAYGOVIND JHA** of MSc. Part II Physics Sem-IV class, has successfully completed the required Project **PIEZO ELECTRIC HARVESTING: TOWARDS GREEN ENERGY** and has got his project duly assinned in the laboratory course during the academic year 2022-2023 as per the prescribed syllabus by the **UNIVERSITY OF MUMBAI .**

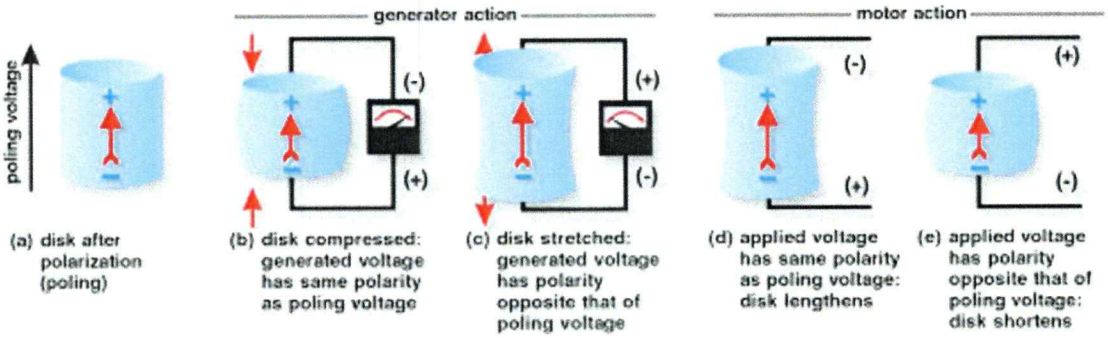
14/07/23 18/07/23

**Project Guide** **Examiner** **Head of Department**

S. D. APTE COMM. & MEHTA SCIENCE COLLEGE DEPT. OF PHYSICS PALGHAR

# ABSTRACT

Mechanical compression or tension on a poled piezoelectric ceramic element changes the dipole moment, creating a voltage. Compression along the direction of polarization, or tension perpendicular to the direction of polarization, generates voltage of the same polarity as the poling voltage (Figure 1.1 b). Tension along the direction of polarization, or compression perpendicular to the direction of polarization, generates a voltage with polarity opposite that of the poling voltage (Figure 1.1 c). These actions are generator actions -- the ceramic element converts the mechanical energy of compression or tension into electrical energy. This behavior is used in fuel-igniting devices, solid state batteries, force-sensing devices, and other products. Values for compressive stress and the voltage (or field strength) generated by applying stress to a piezoelectric ceramic element are linearly proportional up to a material-specific stress. The same is true for applied voltage and generated strain.




* Generator action is used in fuel-igniting devices, solid state batteries, and other products, motor action is adapted to piezoelectric motors, sound or ultrasound generating devices, and many other products

Fig : generator actions in piezoelectric

## ACKNOWLEDGEMENT

We would like to thank respected principal of our college **DR.KIRAN J.SAVE** for his motivation throughout this project We are also thankful to our H.O.D.**PROF. B.K.SAKHARE** for his guidance and advice in project to complete our project. We are also thankful to **DR. SAPNA B. JADHAV** and **PROF. UTKARSHA SAVE** because of her valuable guidance.

It is our privilege to acknowledge with deep sense of gratitude to our project guide for their valuable suggestions and guidance throughout our course of study and timely help given to us in the completion of our project. They took deep interest in checking the minute details of the report and guided us throughout the same. Their constant source of inspiration. We all are sincerely thankful to our project guide.

Last but not the least, We would like to thank all our friends who have been a constant source of inspiration to us during entire course of my project wouldn't have been possible. We are grateful to all the staff members, non-teaching staff for giving us the helping hand.

# DECLARATION

I hereby declare that the Project entitled done at Sonopant Dandekar College Palghar is record of original work done by me under the guidance of **Dr. Sapna B. Jadhav**, Head of Department **Professor. B.K.Sakhre** Department of Physics. The Project is done in partial fulfillment of the requirements for the award of degree of **MASTER OF SCIENCE PHYSICS** to be submitted as Semester-IV Project as part of our curriculum.

# TABLE OF CONTENT

# 1.INTRODUCTION

Energy in environment, such as heat, light, wind, vibration can be collected and converted into electrical energy which can be stored and transmitted easily, deliver power directly to the electric elements or stored in batteries, ultra-capacitors, and this process is called energy harvesting . Piezoelectric energy harvesting is mainly for mechanical vibration, it's widespread in everyday life, such as refrigerators, washing machines, industrial equipment, vehicles caused by vibration . Highway carries the main road traffic demands, mechanical vibration energy of highway vehicles can be enormous.

Piezoelectric materials are electrically charged when stressed, and how much it is electrically charged is determined by the force, characteristics, electromechanical coupling of piezoelectric material performance and structure . Piezoelectric materials are core components of piezoelectric energy harvesting, advances in materials research determines the energy collection efficiency.

## 1.1 Aim of this project

The application for this energy harvesting system is for transportation, collecting energy available from an ordinary, heavily traveled highway. The system captures energy from the sunshine on the road and from the deformation of the road surface as cars pass by. This project's deliverable is a small scale prototype having all of the basic functions of such an energy collection system, mounted on a set of circuit boards, sensors with mounts, and displays. No hardened packaging is specified or expected.

Such an energy collection system, as an end product, can become quite complicated. To make the project feasible, we simplify it to its basic elements of photovoltaic energy collection, piezoelectric energy collection energy processing and storage, wireless communication and control, and information display.

## 1.2 Research Problem Statement

There are over 200 piezoelectric materials that could be used for energy harvesting, with the appropriate ones being selected for each application. Although barium titanate was the first piezoelectric ceramic discovered, the ceramic lead zirconate titanate, also known as PZT, is still the most commonly used material for piezoelectric harvesting. Alternatives are receiving some attention, usually where efficiency and temperature performance of the material itself is not the primary consideration but factors such as flexibility, light weight or even toxicity concerns come to the fore. For instance, sodium potassium niobate exhibits properties very similar to PZT without containing lead; or there are polymer piezoelectric materials such as polyvinylidene difluoride, in which piezoelectricity is due to intertwined long-chain molecules attracting and repelling each other when an electric field is applied A challenge of piezoelectrics is that while they are efficient at optimal resonance, only a slight variation away from the optimal resonant frequency causes a significant reduction in energy generation - the bell curve is very steep.

## 1.3 Objectives

1) With the social and economic development, along with the continued depletion of fossil energy, declining environmental quality, combined with our sustainable development strategy, how to efficiently collect and facilitate clean energy has been the focus of energy research .
2) Stairs as a national critical infrastructure, undertakes the transportation of people, goods, and other important functions . On the stairs , thousands of people generate vibration on the stairs, which is very considerable, stairs-steps vibration can not only cause damage to stairs, but also lead to a waste of energy.
3) How to collect vibration energy, turning it into the energy available for people to use is the problem that need to be solved . At present, based on the conversion mechanism, collecting environmental vibration energy devices can be divided into three types: electromagnetic, piezoelectric and electrostatic .
4) Piezoelectric energy harvesting technology utilize the characteristic of electromechanical coupling of piezoelectric materials, directly convert mechanical energy to electrical energy, compared to electromagnetic and electrostatic generating, piezoelectric power generation with original small size, does not need an external power supply-driven and so on .
5) Based on these advantages, the piezoelectric technology has developed rapidly, but most piezoelectric devices are used to collect fixed mechanical equipment vibration energy, tidal and wind power, the application of piezoelectric technology in the stairs is still in the research stage . Both at homeland and abroad, piezoelectric stairs in theoretical research has achieved certain results, but on the whole is still in its initial stages. We have tried to do further research.

# 2. THEORETICAL FRAMEWORK

## 2.1SOFTWARE COMPONENTS

1. KEIL MICROVISION 5
2. PROTEUS 8 PROFESSIONAL

## 2.2 HARDWARE COMPONENTS

1. Piezo material
2. Diode
3. Full wave bridge rectifier
4. Super capacitor batteries
5. Battery management system
6. Battery
7. LDR
8. Bc 547 transistor

# 3. EXPERIMENTAL METHOD

## 3.1 Basic Modules

### 3.1.1 Block Diagram

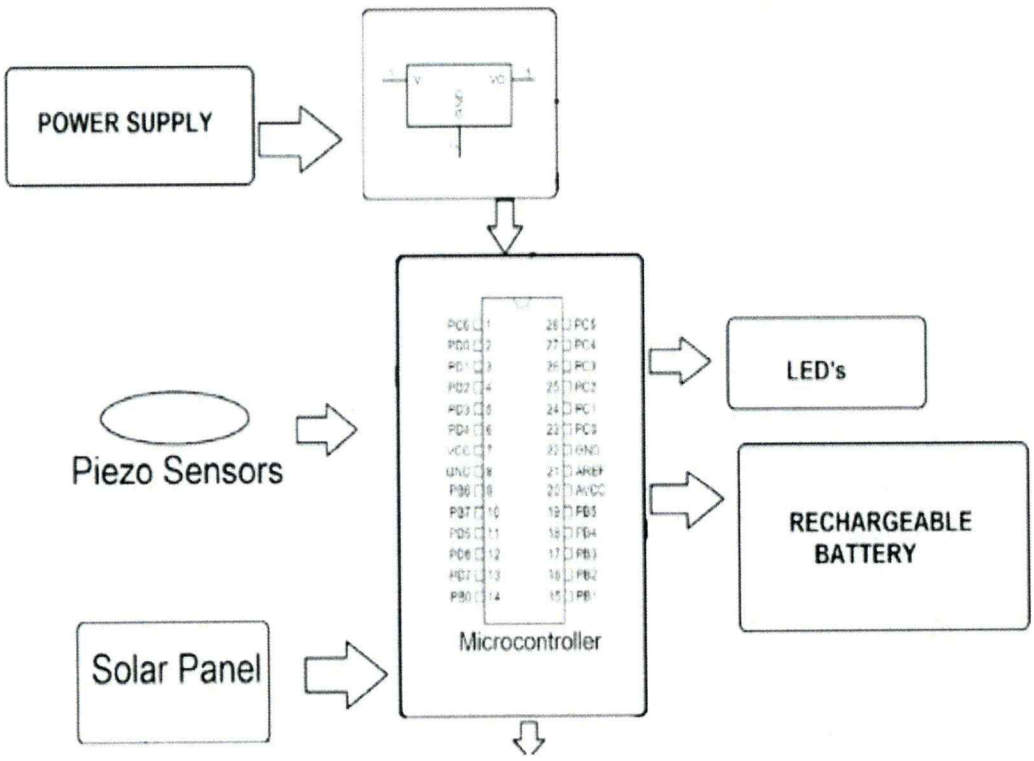



Fig 3.1.1 Block Diagram

### 3.1.2 Circuit Diagram

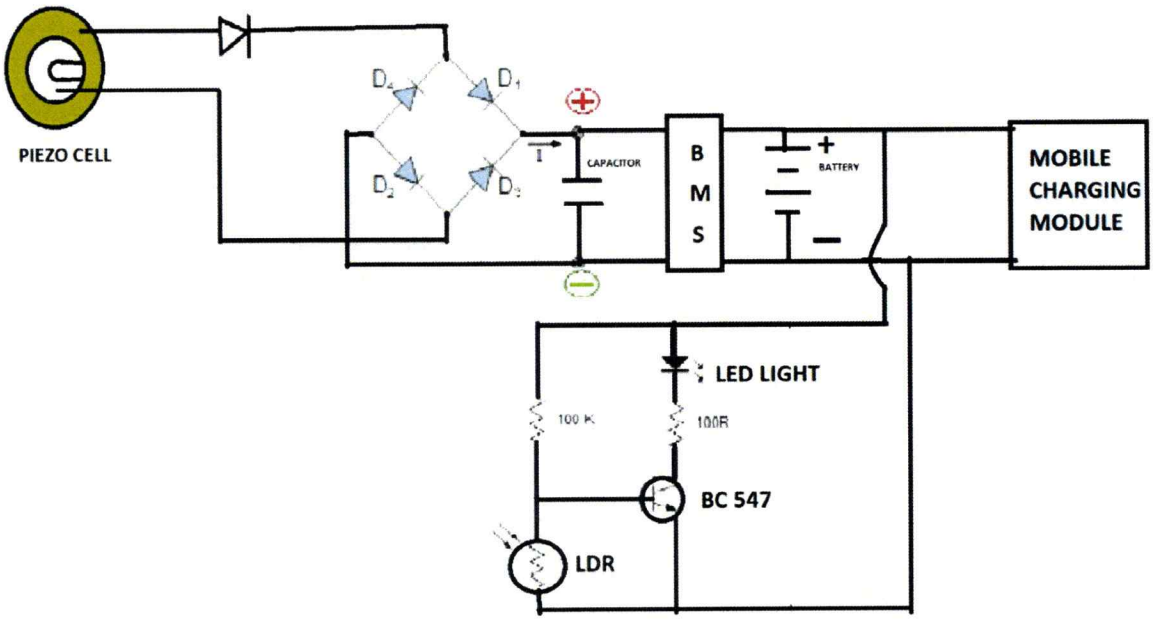



Fig 3.1.2 Circuit Diagram

### 3.1.3 Pin Diagram

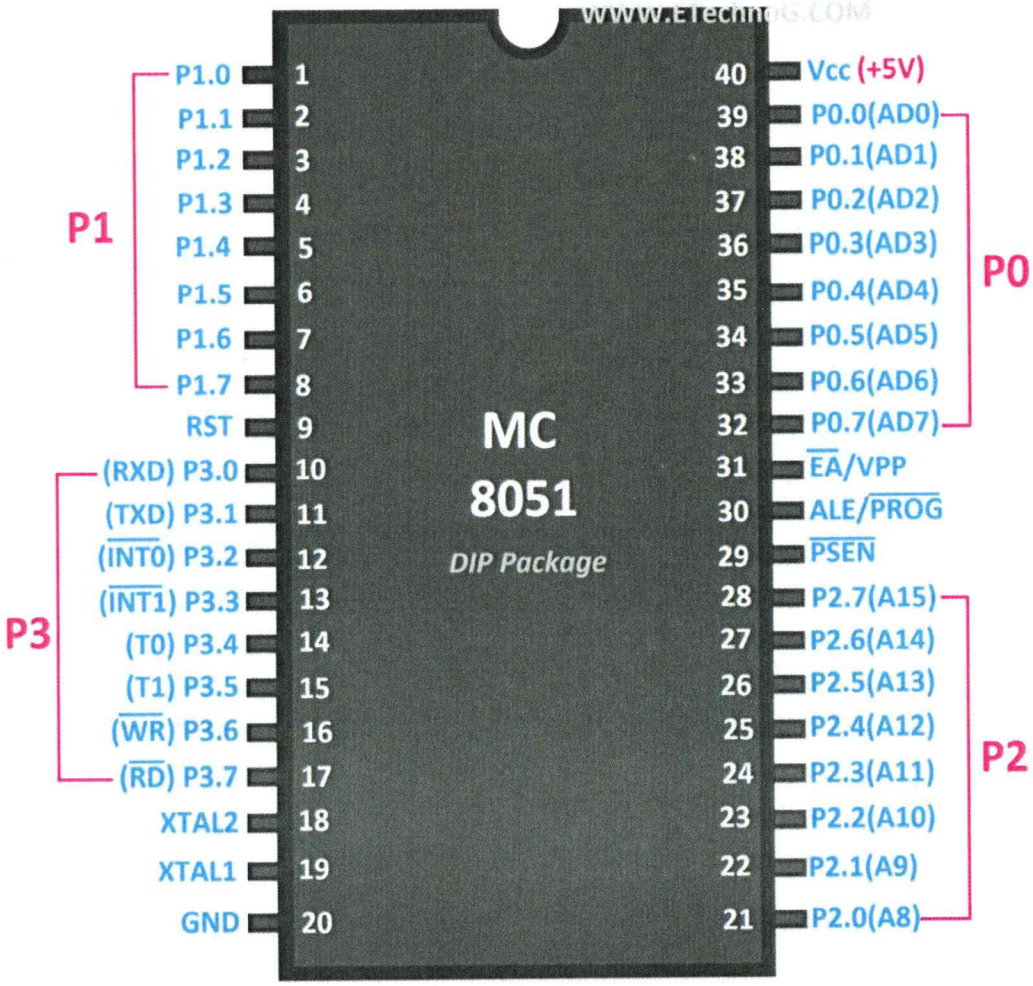



Fig 3.1.3 Pin Diagram of 8051 microcontroller

# 4. DESIGN & IMPLEMENTATION

## 4.1 Circuit explanation & working of the system

The proposed energy harvesting system operates under the principle that, when a force is applied to piezoelectric devices, mechanical stresses are accumulated. Under these conditions, when an electric current is passed through the polarity arrangement, an electric potential is generated at both terminals. We have connected diodes to piezo sheets to oppose the back flow of the current. A **diode** is a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction. Power Diodes can be connected together to form a full wave rectifier that convert AC voltage into pulsating DC voltage for use in power supplies.

The full wave rectifier converts both halves of each waveform cycle into pulsating DC signal using four rectification diodes. Subsequently, the generated energy is passed through a rectifier circuit to transform the AC produced to a DC, which is then used for powering the operation of the battery and the connected electronics. Super capacitors are ideal when a quick charge is needed to fill a short-term power need; whereas batteries are chosen to provide long-term energy. Combining the two into a hybrid battery satisfies both needs and reduces battery stress, which reflects in a longer service life. Super capacitors are most effective to bridge power gaps lasting from a few seconds to a few minutes and can be recharged quickly. Battey management system is used to : Ensure reliable battery operations, Continuous battery health monitoring to avoid explosion , Increases the life span of the battery, Indicates battery level. Lithium-ion is the most popular rechargeable battery used today. Lithium-ion batteries power the devices we use every day, like our mobile phones and electric vehicles. Lithium-ion batteries consist of single or multiple lithium-ion cells, along with a protective circuit board. They are referred to as batteries once the cell, or cells, are installed inside a device with the protective circuit board.

LDR is a light-dependent resistor that changes its resistance when different amounts of light fall on it. They work on the principle of photo conductivity where it gives less resistance in high light intensity and high resistance in low light intensity. In other words, it gives high resistance at night and low resistance in day. The BC547 transistor is an NPN transistor. A transistor is nothing but the transfer of resistance which is used for amplifying the current. A small current of the base terminal of this transistor will control the large current of emitter and base terminals. The main function of this transistor is to amplify as well as switching purposes.It is a dark detector circuit based on LDR and a transistor (BC-547 NPN) which automatically switches ON and OFF the street light system.

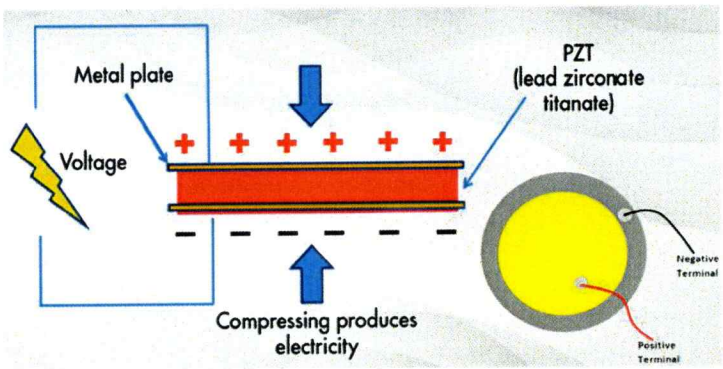



**Fig 4.1 Working implementation of PZT**

## 4.2 Connection of piezo sensors

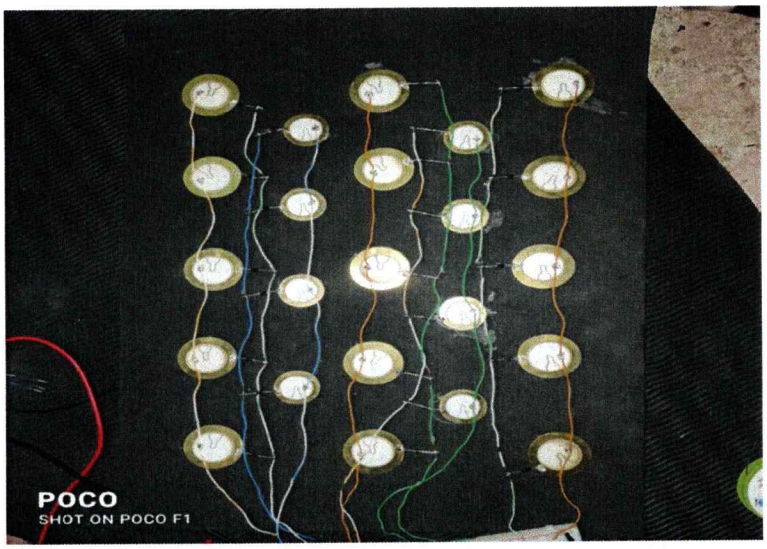



Fig 4.2 Connection of piezo-sensors

## 4.3 Interfacing of microcontroller 8051 with piezoelectric sensors.

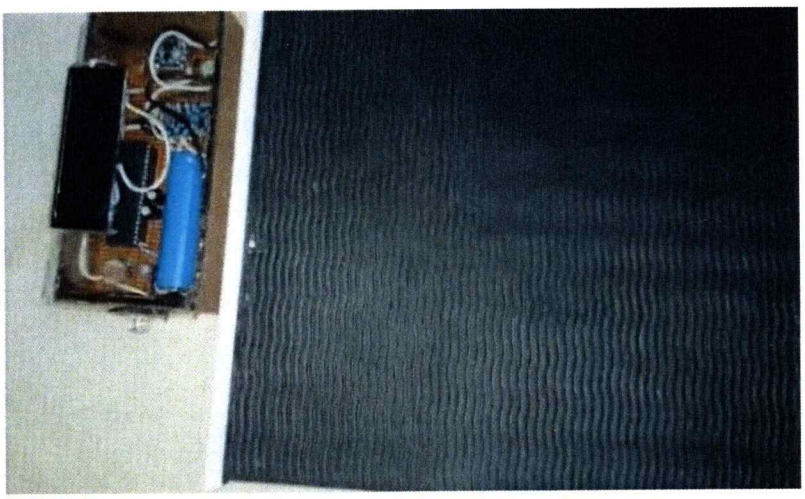


Fig 4.3 Interfacing of microcontroller 8051 with piezoelectric

## 4.4 Coding in Assembly C++ Language

```
#include<reg51.h>
                    #define lcd P1
                    sbit rs=P3^6;
                    sbit e=P3^7;
                    sbit relay=P0^0;
                    sbit s1=P2^0;
                    sbit s2=P2^1;
                    void delay (int);
                    void cmd (char);
                    void display (char);
                    void init (void);
                    void string (char *);
                    void view (int);
                    int count=0;
                    int no[10]={48,49,50,51,52,53,54,55,56,57};
                    void delay (int d)
                    {
                            unsigned char i=0;
                            for(;d>0;d--)
                            {
                                    for(i=250;i>0;i--);
                                    for(i=248;i>0;i--);
                            }
                    }
                    void cmd (char c)
                    {
                            lcd=c;
                            rs=0;
                            e=1;
                            delay(5);
                            e=0;
                    }
                    void display (char c)
                    {
                            lcd=c;
                            rs=1;
                            e=1;
```

```
        delay(5);
        e=0;
}
void string (char *p)
{
        while(*p)
        {
                display(*p++);
        }
}
void view (int n)
{
        cmd(0xc0);
        display(no[(n/10)%10]);
        display(no[n%10]);
}
void init (void)
{
        cmd(0x38);
        cmd(0x0c);
        cmd(0x01);
        cmd(0x80);
}
void main()
{
  init();
        string("counter........");
        cmd(0xc0);

        view(count);


        while(1)
        {
                if(s1==1)
                {
                        while(s2==0);
                        if(count!=99)
                        count=count+1;
```

```
                while(s2==1);
                view(count);
            }
            else if(s2==1)
            {
                while(s1==0);
                if(count!=0)
                count=count-1;
                while(s1==1);
                view(count);
            }
            else if(count==1)
                relay=0;
            else if(count==0)
                relay=1;

        }
    }
```

## 4.5 Outputs

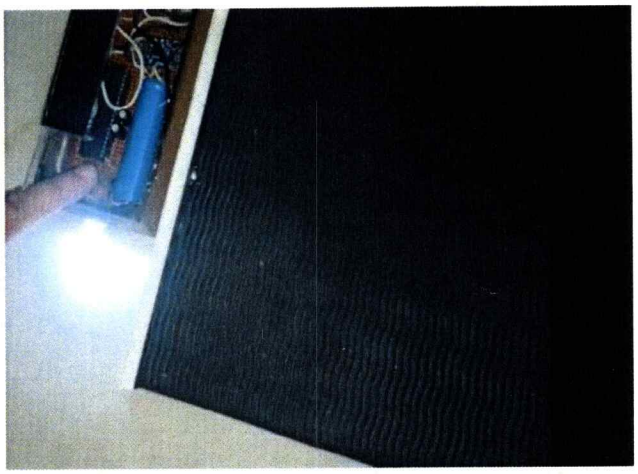


Fig 4.5.1 Glowing of LED

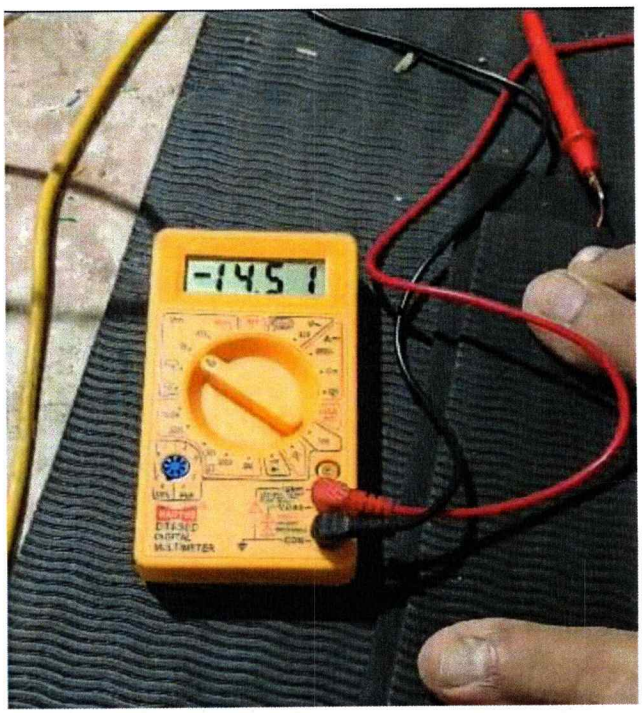



Fig 4.5.2 Potential Difference recorded on DMM

# 5. RESULT & DISCUSSION

Among all the ambient energy sources, mechanical energy is the most ubiquitous energy that can be captured and converted into useful electric power . Piezoelectric energy harvesting is a very convenient mechanism for capturing ambient mechanical energy and converting it into electric power since the piezoelectric effect is solely based on the intrinsic polarization of the material and it does not require a separate voltage source, magnetic field, or contact with another material as in the case of electrostatic, electromagnetic, and triboelectric energy harvesting, respectively . Piezoelectric generators are durable, reliable, more sensitive to minute strains, and exhibit ~3–5-fold higher density power output and higher voltage output compared to the other energy harvesting methods . Moreover, piezoelectric generators can be manufactured in small dimensions and compact structures, and easily integrated into microelectromechanical systems. Further, they are not affected by environmental factors such as humidity . Thus, piezoelectric transduction is the most promising ambient energy harvesting technology that has found applications in many diverse field.

## * SOLAR PANEL PERFORMANCE

- Solar panel performance was measured in three different conditions as shown in Table
- The solar panel was first exposed to the sunlight. Then half of the solar panel was shaded. Finally, the whole solar panel was shaded. The current shown was transmitted directly to charge the battery.

Table 1. Solar Panel Performance:

| Conditions | V(DC) Volt | A(Amps) |
|---|---|---|
| Max (under sun light) | 21.44 | 0.268 |
| One panel (half shaded) | 17.34 | 0.0074 |
| Under the shade | 15.87 | 0.019 |

## * PIEZOELECTRIC PERFORMANCE

Piezoelectric Energy Collection

A piezoelectric transducer comprises a "crystal" sandwiched between two metal plates. When a sound wave strikes one or both of the plates, the plates vibrate. The crystal picks up this vibration, which it translates into a weak AC voltage. Specification for the piezoelectric transducer[2] are as follows:

- Max input voltage 20 Vp-p
- Resonant frequency 4600 Hz
- Resonant impedance 250 Ohm
- Plate material Brass
- Operation temperature -20 ~ +70 C
- Storage temperature -30 ~ +80 C

Piezoelectric: The piezoelectric system charged its capacitor to 15 Volts. The microcontroller's main function is to get the voltage to 15V and then switch the relay to the battery to discharge. It performed as expected. The maximum current transferred to the battery was 6mA.

# 6. FUTURE SCOPE

Piezoelectric energy harvesting has become an extremely extensive field of research during the past two decades. materials and transducers have been extensively employed to develop application-based devices to harvest energy from fluid flow, the human body, animals, infrastructure, and vehicles. There has been a major interest in the researcher community to develop various wearable and implantable energy harvesting devices to power portable electronics as well as medical devices.

# 7. CONCLUSION

Piezoelectric devices have attracted more attention than other mechanical energy harvesting methods due to their certain advantages such as higher power output density, scalability, and the simplicity of the required external circuitry. The research on mechanical energy harvesting mostly focused on converting the energy in ambient vibrations; however, PEHs can convert the energy in varying pressure as well, which increases their potential applications. Piezoelectric energy harvesting has been demonstrated in different scales from several m2 piezoelectric floors to sub-micron nanowire arrays. Large scale piezoelectric energy harvesting demonstrations so far aim to provide power for nearby lighting or sensing systems in an effort to reduce the effective energy consumption of the overall system. On the other hand, the ultimate goal of smaller scale energy harvesters is mostly creating self-powered systems. Improvements in piezoelectric energy harvesting and decreasing power requirements of CMOS circuits brought the supplied and required power levels close to each other, which brings us closer to such systems. There are still certain challenges in PEHs such as increasing the operation bandwidth, developing CMOS compatible processes for integrated devices, or fabricating biocompatible devices for implants. Another important issue arises due to the availability level of harvestable energy, which is almost impossible to predict beforehand. Therefore, the system should be able to harvest energy whenever it is available and store it for later use. Storage of the harvested energy requires the AC outputs of PEHs be rectified using impedance-matched electrical circuits. The rectification and storage processes have their own losses as well, which would reduce the already low amount of harvested energy. Nevertheless, there is an ongoing research effort focused on these problems and new solutions are being proposed continuously.

# 8. REFERENCES

1] Rodriguez, Arturo & Love, Norman & Castellanos, Alejandra & Valles, Rogelio & Morales, Daniela. (2018). Literature Review of Piezoelectric Sensor for Energy Applications. [4] Mohamad, Syahrul

2] Hisham & Thalas, M.F. & Noordin, Aminurrashid & Yahya, M.S. & Hassan, M.H.C. & Ibrahim, Z. (2015). A potential study of piezoelectric energy harvesting in-car vibration. 10. 8642-8647.

3] Heung Soo Kim1, Joo-Hyong Kim2 and Jaehwan Kim A Review of Piezoelectric Energy Harvesting Based on Vibration INTERNATIONAL JOURNAL OF PRECISION ENGINEERING AND MANUFACTURING Vol. 12, No. 6, pp. 1129-1141

4] Anton S R and Sodano H A 2007 A review of power harvesting using piezoelectric materials (2003–2006) *Smart Mater. Struct.* **16** R1

5] Sullivan J and Gaines L 2010 *A review of battery life-cycle analysis: state of knowledge and critical needs ANL/ESD/10-7* Argonne National Laboratory (ANL)

6] Harne R and Wang K 2013 A review of the recent research on vibration energy harvesting via bistable systems *Smart Mater. Struct.*

# 9. APPENDIX

## 9.1 Piezo material

A piezoelectric plate is a device that uses the piezoelectric effect to measure pressure, acceleration strain or force by converting them to an electrical charge. Piezoelectricity is the electricity generated by piezo element by effect called the piezoelectric effect. It is the ability of certain materials to generate an AC (alternating current) voltage when subjected to mechanical stress or vibration, or to vibrate when subjected to an AC voltage, or both. The most common piezoelectric material is quartz. Certain ceramics, Rochelle salts, and various other solids also exhibit this effect. When a sound wave strikes one or both sides of the plates, the plates vibrate. The crystal picks up this vibration, which it translates into a weak AC voltage. Therefore, an AC voltage arises between the two metal plates, with a waveform similar to that of the sound waves. Conversely, if an AC signal is applied to the plates, it causes the crystal to vibrate in sync with the signal voltage. As a result, the metal plates also vibrates and produce an acoustic disturbance.

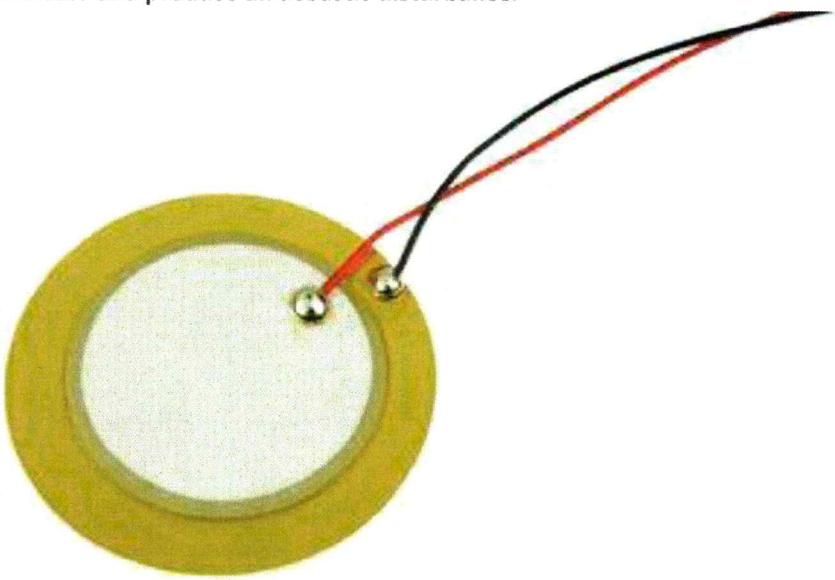


Fig. 9.1 : Piezo material

## 9.2 Solar Panel

Solar panels collect clean renewable energy in the form of sunlight and convert that light into electricity which can then be used to provide power for electrical loads. Solar panels are comprised of several individual solar cells which are themselves composed of layers of silicon, phosphorous (which provides the negative charge), and boron (which provides the positive charge). Solar panels absorb the photons and in doing so initiate an electric current. The resulting energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their atomic orbits and released into the electric field generated by the solar cells which then pull these free electrons into a directional current. This entire process is known as the Photovoltaic Effect. An average home has more than enough roof area for the necessary number of solar panels to produce enough solar electricrity to supply all of its power needs excess electricity generated goes onto the main power grid, paying off in electricity use at night.

In a well-balanced grid-connected configuration, a solar array generates power during the day that is then used in the home at night. Net metering programs allow solar generator owners to get paid if their system produces more power than what is needed in the home. In off-grid solar applications, a battery bank, charge controller, and in most cases, an inverter are necessary components. The solar array sends direct current (DC) electricity through the charge controller to the battery bank. The power is then drawn from the battery bank to the inverter, which converts the DC current into alternating current (AC) that can be used for non-DC appliances. Assisted by an inverter, solar panel arrays can be sized to meet the most demanding electrical load requirements.

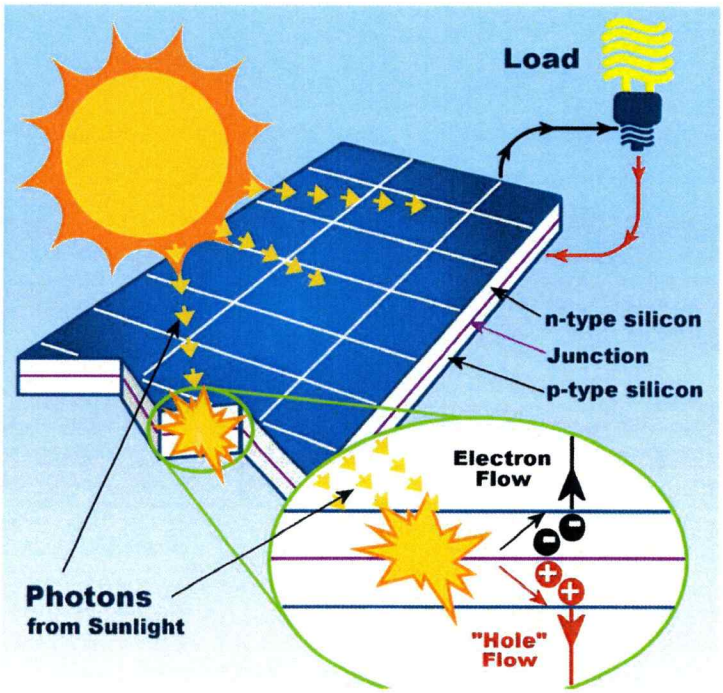



Fig 9.2 SOLAR PANEL

# 9.3 8051 MICROCONTROLLER

## Features

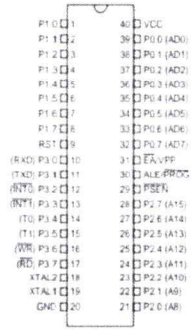
- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory
  - Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

## Description

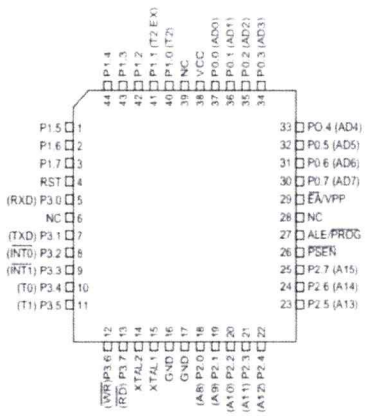
The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

## Pin Configurations

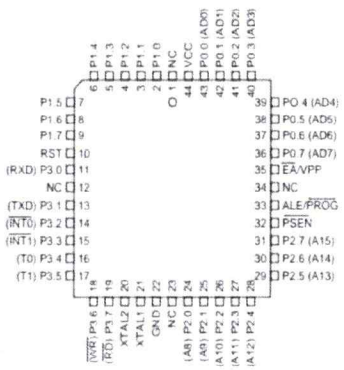
PDIP




PQFP/TQFP




PLCC




# 8-bit Microcontroller with 4K Bytes Flash

## AT89C51

**Not Recommended for New Designs. Use AT89S51.**

Rev. 0265G–02/00

## Block Diagram

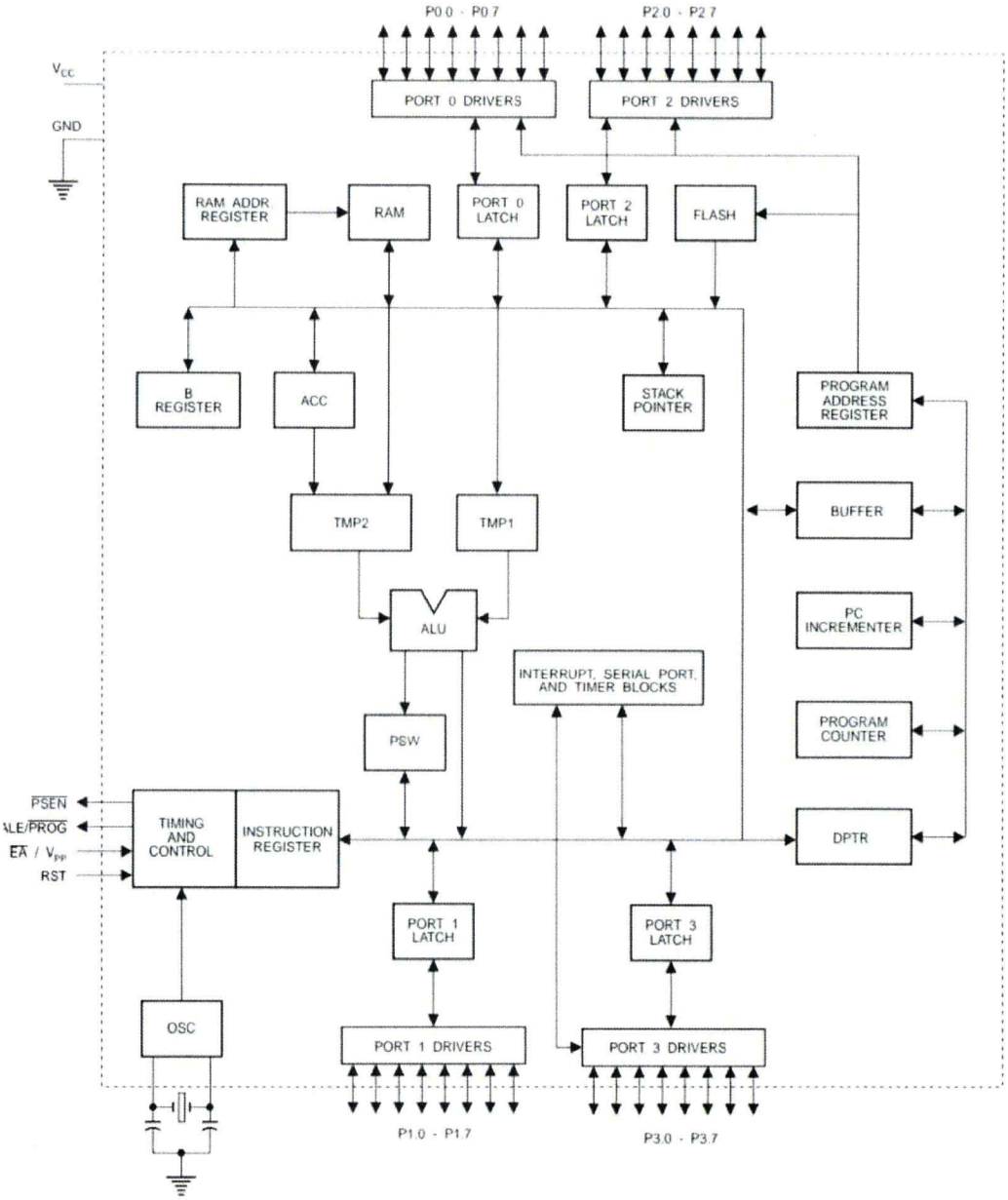



**Fig 9.3.1 Block diagram of 8051**

The AT89C51 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

## Pin Description

### VCC

Supply voltage.

### GND

Ground.

### Port 0

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs.

Port 0 may also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode P0 has internal pullups.

Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pullups are required during program verification.

### Port 1

Port 1 is an 8-bit bi-directional I/O port with internal pullups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current ($I_{IL}$) because of the internal pullups.

Port 1 also receives the low-order address bytes during Flash programming and verification.

### Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pullups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current ($I_{IL}$) because of the internal pullups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, it uses strong internal pullups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

### Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current ($I_{IL}$) because of the pullups.

Port 3 also serves the functions of various special features of the AT89C51 as listed below:

| Port Pin | Alternate Functions |
|---|---|
| P3.0 | RXD (serial input port) |
| P3.1 | TXD (serial output port) |
| P3.2 | $\overline{INT0}$ (external interrupt 0) |
| P3.3 | $\overline{INT1}$ (external interrupt 1) |
| P3.4 | T0 (timer 0 external input) |
| P3.5 | T1 (timer 1 external input) |
| P3.6 | $\overline{WR}$ (external data memory write strobe) |
| P3.7 | $\overline{RD}$ (external data memory read strobe) |

Port 3 also receives some control signals for Flash programming and verification.

### RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

### ALE/$\overline{PROG}$

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input ($\overline{PROG}$) during Flash programming.

In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE

pulse is skipped during each access to external Data Memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

**$\overline{\text{PSEN}}$**

Program Store Enable is the read strobe to external program memory.

When the AT89C51 is executing code from external program memory, $\overline{\text{PSEN}}$ is activated twice each machine cycle, except that two $\overline{\text{PSEN}}$ activations are skipped during each access to external data memory.

**$\overline{\text{EA}}$/VPP**

External Access Enable. $\overline{\text{EA}}$ must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, $\overline{\text{EA}}$ will be internally latched on reset.

$\overline{\text{EA}}$ should be strapped to $V_{CC}$ for internal program executions.

This pin also receives the 12-volt programming enable voltage ($V_{PP}$) during Flash programming, for parts that require 12-volt $V_{PP}$.

**XTAL1**

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

**XTAL2**

Output from the inverting oscillator amplifier.

## Oscillator Characteristics

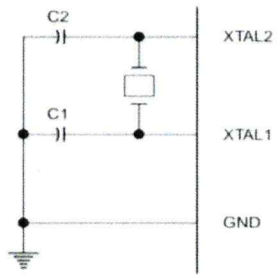
XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure 2. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

## Idle Mode

In idle mode, the CPU puts itself to sleep while all the on-chip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and all the special functions registers remain unchanged during this mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset.

It should be noted that when idle is terminated by a hard ware reset, the device normally resumes program execution, from where it left off, up to two machine cycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access to the port pins is not inhibited. To eliminate the possibility of an unexpected write to a port pin when Idle is terminated by reset, the instruction following the one that invokes Idle should not be one that writes to a port pin or to external memory.

**Figure 1.** Oscillator Connections

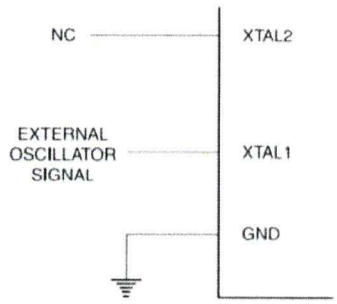



Note: C1, C2 = 30 pF ± 10 pF for Crystals
= 40 pF ± 10 pF for Ceramic Resonators

## Status of External Pins During Idle and Power-down Modes

| Mode | Program Memory | ALE | $\overline{\text{PSEN}}$ | PORT0 | PORT1 | PORT2 | PORT3 |
|---|---|---|---|---|---|---|---|
| Idle | Internal | 1 | 1 | Data | Data | Data | Data |
| Idle | External | 1 | 1 | Float | Data | Address | Data |
| Power-down | Internal | 0 | 0 | Data | Data | Data | Data |
| Power-down | External | 0 | 0 | Float | Data | Data | Data |

**Figure 2.** External Clock Drive Configuration




## Power-down Mode

In the power-down mode, the oscillator is stopped, and the instruction that invokes power-down is the last instruction executed. The on-chip RAM and Special Function Registers retain their values until the power-down mode is terminated. The only exit from power-down is a hardware reset. Reset redefines the SFRs but does not change the on-chip RAM. The reset should not be activated before $V_{CC}$ is restored to its normal operating level and must be held active long enough to allow the oscillator to restart and stabilize.

## Program Memory Lock Bits

On the chip are three lock bits which can be left unprogrammed (U) or can be programmed (P) to obtain the additional features listed in the table below.

When lock bit 1 is programmed, the logic level at the $\overline{EA}$ pin is sampled and latched during reset. If the device is powered up without a reset, the latch initializes to a random value, and holds that value until reset is activated. It is necessary that the latched value of $\overline{EA}$ be in agreement with the current logic level at that pin in order for the device to function properly.

## Lock Bit Protection Modes

| Program Lock Bits | | | | |
|---|---|---|---|---|
| | LB1 | LB2 | LB3 | Protection Type |
| 1 | U | U | U | No program lock features |
| 2 | P | U | U | MOVC instructions executed from external program memory are disabled from fetching code bytes from internal memory, $\overline{EA}$ is sampled and latched on reset, and further programming of the Flash is disabled |
| 3 | P | P | U | Same as mode 2, also verify is disabled |
| 4 | P | P | P | Same as mode 3, also external execution is disabled |

**SONOPANT DANDEKAR ARTS V. S APTE COMMERCE AND M.HMEHTA SCIENCE COLLEGE PALGHAR DIST-POST-TAL-PALGHAR**

**CODE:(02525)252163, PRIN: 252317 RESI: 252316**

# DEPARTMENT OF PHYSICS

**UNIVERSITY OF MUMBAI**

A PROJECT REPORT ON

**" OTP BASED LOCK SYSTEM USING ARDINUO. "**

SUBMITTED

UNDER THE GUIDANCE OF

**DR. SAPNA B. JADHAV**

**&**

**PROFESSOR UTKARSHA SAVE**

MASTER OF SCIENCE

PHYSICS

2022-2023

**UNIVERSITY OF MUMBAI**

SONOPANT DANDEKAR ARTS V.S.APTE COMMERCE AND M.H.MEHTA SCIENCE COLLEGE PALGHAR DIST-POST-TAL-PALGHAR

CODE: (02525)252163, PRIN: 252317 RESI: 252316

DEPARTMENT OF PHYSICS

SEAT NO- 4140741

## CERTIFICATE

This is to certify that **MAYUR BABALU GOVIND** of MSc. Part II Physics Sem-IV class, has successfully completed the required Project **OTP BASED LOCK SYSTEM USING ARDUINO** and has got his project duly assigned in the laboratory course during the academic year 2023-2024 as per the prescribed syllabus by the **UNIVERSITY OF MUMBAI**.

15/07/23 18/07/23

**PROJECT GUIDE** **EXAMINAR** **HEAD OF DEPARMENT**

S. D. APTE COMM. & MEHTA SCIENCE COLLEGE DEPT. OF PHYSICS PALGHAR

# OTP BASED LOCK SYSTEM USING ARDUINO

# DECLARATION

I hereby declare that the Project entitled done at Sonopant Dandekar College Palghar is record of original work done by me under the guidance of **Professor. Dr. Sapna B. Jadhav**, Head of Department **Professor. B.K.Sakhre** Department of Physics. The Project is done in partial fulfillment of the requirements for the award of degree of **MASTER OF SCIENCE PHYSICS** to be submitted as Semester-IV Project as part of our curriculum.

# ACKNOWLEDGEMENT

I take this opportunity to express my gratitude towards the Department of Physics SONOPANT DANDEKAR SHIKSHAN MANDALI'S (SDSM), Palghar who gave me opportunity for presentation of my project in their stemmed organization. The successful compilation of any task would be incomplete without mentioning all those people who make it possible the content and encouragement crowns the effort with success.

I will thank our Head of Department PROF. B. K. SAKHARE sir for providing guidance throughout the course and all those who have indirectly guided and helped in preparation of the projects in their estimated organization. I have been associated with a great pleasure that I express my deep sense of constant encouragement & patience through her work.

I express my thanks to my project guide DR. SAPNA JADHAV for this constant encouragement, cooperation & motivation and Prof. UTKARSHA SAVE valuable help throughout the project work to make it successful.

# TABLE OF CONTENTS

# INTRODUCTION

This Thesis inspects and presents an innovation for a savvy entryway dependent on the ideas of web of things (IOT). With the quick progression of the IOT market, organizations will in general zero in on an opportunity to showcase and delivering item as quick as conceivable as opposed to building up a protected considerable item. This leaves numerous IOT items with satisfactory assurance against different types of malignant assaults. IOT security is an always developing issue and regardless of whether there is a lot of examination on the point there isn't a lot of considerable work about executions or normalizations that could take care of this issue. IOT security is of all things considered significance as the result of security breaks in IOT can be obliterating. A penetrate in a keen vehicle or shrewd entryway lock could prompt taken items or even setbacks in some extraordinary cases. Regardless of whether an undetected break isn't abused yet existing it gives the item proprietor a misguided sensation that all is well and good which is morally inadmissible. Due to the irregularity of IOT items, their design and the innovation utilized it is difficult to create steady safety efforts that cover the whole range of various gadgets. Thusly will the IOT items be created around wellbeing norms rather than the alternate way. For this theory, we have decided to work close by a Stockholm based organization called XLENT to build up a safe shrewd entryway lock to get to them. The brilliant entryway lock will be our utilization case in this proposition and will address the normal IOT gadget in our general public. Web of Things (IOT) is a characteristic gathering of related actual articles that are open through the web. The 'thing' in IOT could do what needs to be done, with a heart screen or a vehicle with worked in sensors for example objects that have been given out an IP address and can amass and exchange information over a structure without manual assistance or mediation. The installed advancement in the things makes partner with inside states or the external condition, which thusly impacts the choices taken.

## 1.1 ABSTRACTS

In this world, there is a need of security in pretty much every area for example structures, banks, homes, and so on the grounds that robbery and burglaries are expanded by step by step .to conquer this danger a security framework has been proposed utilizing Arduino and IOT innovation. In this innovation, the secret phrase for security is at first put away in the Electrically Erasable Programmable Read Only Memory [EEPROM]. At the point when the client enters the right secret phrase then the two-way confirmation a haphazardly produced OTP is shipped off the client gadget. On the off chance that the OTP is coordinated, the framework will be opened and required capacity can be started. On the off chance that the OTP isn't right, the client will be furnished with just the set number of possibilities (for example three possibilities in the proposed framework). So, what we need computerized innovation to build a very much incorporated and altered security framework at a sensible cost. Keywords: EEPROM, IOT, Security, OTP.

## 1.2 RESEARCH PROBLES

Password based door lock system using 8051 microcontroller is a simple project where a secure password will not enough to act as a door unlocking system since any body can use the password and open the door.

Password based door lock system using 8051 microcontroller is a simple project where a secure password will not enough to act as a door unlocking system since any body can use the password and open the door.

## 1.3 OBJECTIVE

In this project we are using our own developed algorithm by using random number generation method. The steps are as follows.

- To unlock the lock user has to press button, when this button is pressed the microcontroller gets activated.

- And then the random number generation method called and it creates series of random number.
- The generated number sent to the registered mobile number in the programming part.
- Then the number is stored in the microcontroller.
- After that user has to enter the number which he has received.
- Then the entered the number and the stored number to be compare.
- If both are same or matched the locker will be open.

# 2.THEORITICAL FRAMEWORK

## 2.1 HARDWARE COMPONETS.

1.ARDUINO UNO

2.LCD DISPLAY

3.4*4 HEXKEY PAD

4.GSM MODULE

5.POWER SUPPLY.

## 2.2 SOFTWARE COMPONETS.

1.ARDUINO IDE

2. PROTEUS 8 PROFESSIONAL

• Arduino uno microcontroller: This one is the one of the main entity in this locking system implementation. It is a single board microcontroller and also it has a CPU as a microchip AVR which is a 8 bit. It has SRAM memory and it requires operating voltage of 5 volts and input voltage ranges from 7 to 20 volts.

• Gsm SIM module: In means of communication in this system we are using gsm sim module. We are using promptly available GSM/GPRS module which is called as SIM900A. Commonly these are used in lot of cell phones. This module is a twin band GSM engine and it works on frequencies like EGSM 900MHz and DCS 1800MHz. ARDUINO UNO Buzzer LCD Display GSM module sim 900A 4 X 4 HEX Keypad OTP Mobile POWER SUPPLY International Journal of Research Publication and Reviews Vol (2) Issue (7) (2021) Page 352-356 355

• Liquid crystal display: Liquid crystal display which is commonly called as LCD. This is used in this system to the purpose of displaying messages and notifications which is also acts as an output device. It crates 32 characters to an outline which is tinier than that of most dual line displays.

• Keypad: The keypad which we are using in this technique is acts as an input device. This keyboard is a 4 cross 4 matrix key pad and it actually provides human user interface which is

very useful component for microcontroller project. It has a very thin design and clinging backing. It has an interface of 8 pin access.

- Solenoid lock: This one is the very important component in this system because the system is called as digital locking system so for locking purpose we are using this solenoid lock. This solenoid lock is a 12v so it is an electronic lock, which is basically designed for door, locker etc. It pullout 650mA at 12v and 500mA at 9v when this lock gets activated.

# 3. EXPERIMENTAL METHODS.

## 3.1 BLOCK DIAGRAM.

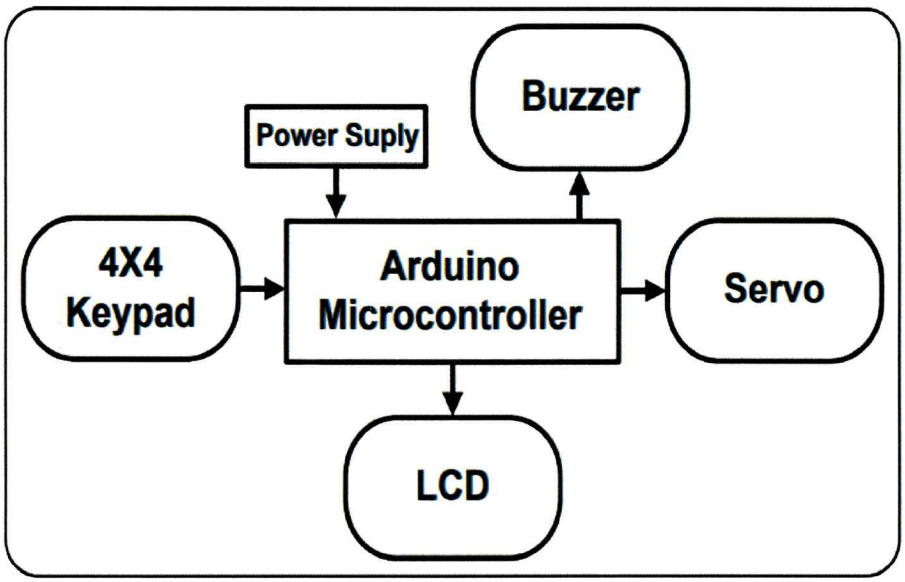



**Figure 3.1 represents the functionalities of this complete digital locking system. Based on the inputs from the user, this locking system can do the following operations :**

- User press the unlock button.
- Arduino microcontroller starts to run.
- OTP is going to generate.
- OTP sent to the registered mobile number.
- User should enter the generated OTP.
- Entered OTP matching with the stored OTP.
- If the entered OTP is valid door will be open or else it remains locked.

## 3.2 PIN CONNECTION CIRCUIT DIAGRAM.

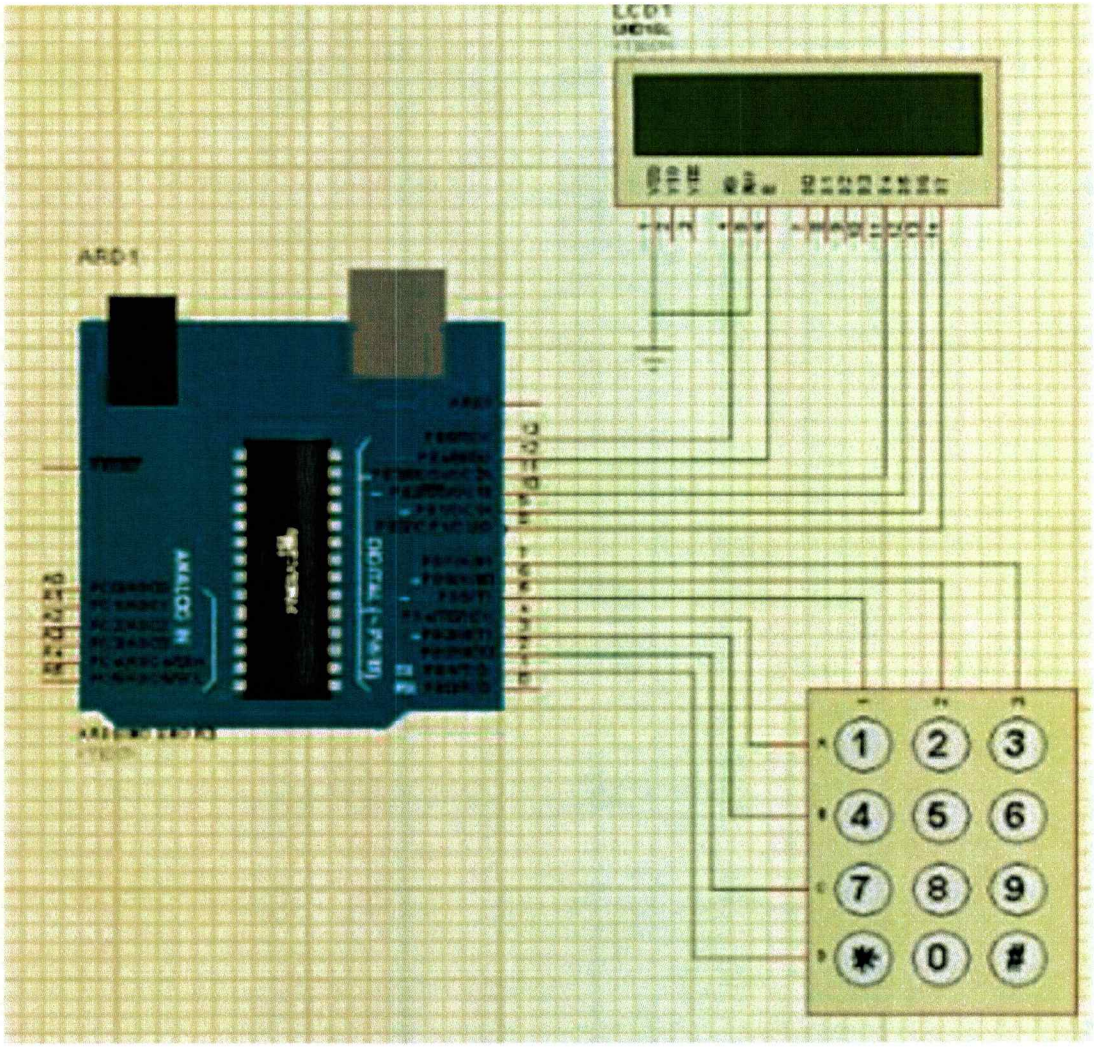



**FIGURE 3.2 CONNECTION CIRCUIT DIAGRAM.**

# 3.3 PIN DIAGRAM OF ARDUINO UNO.

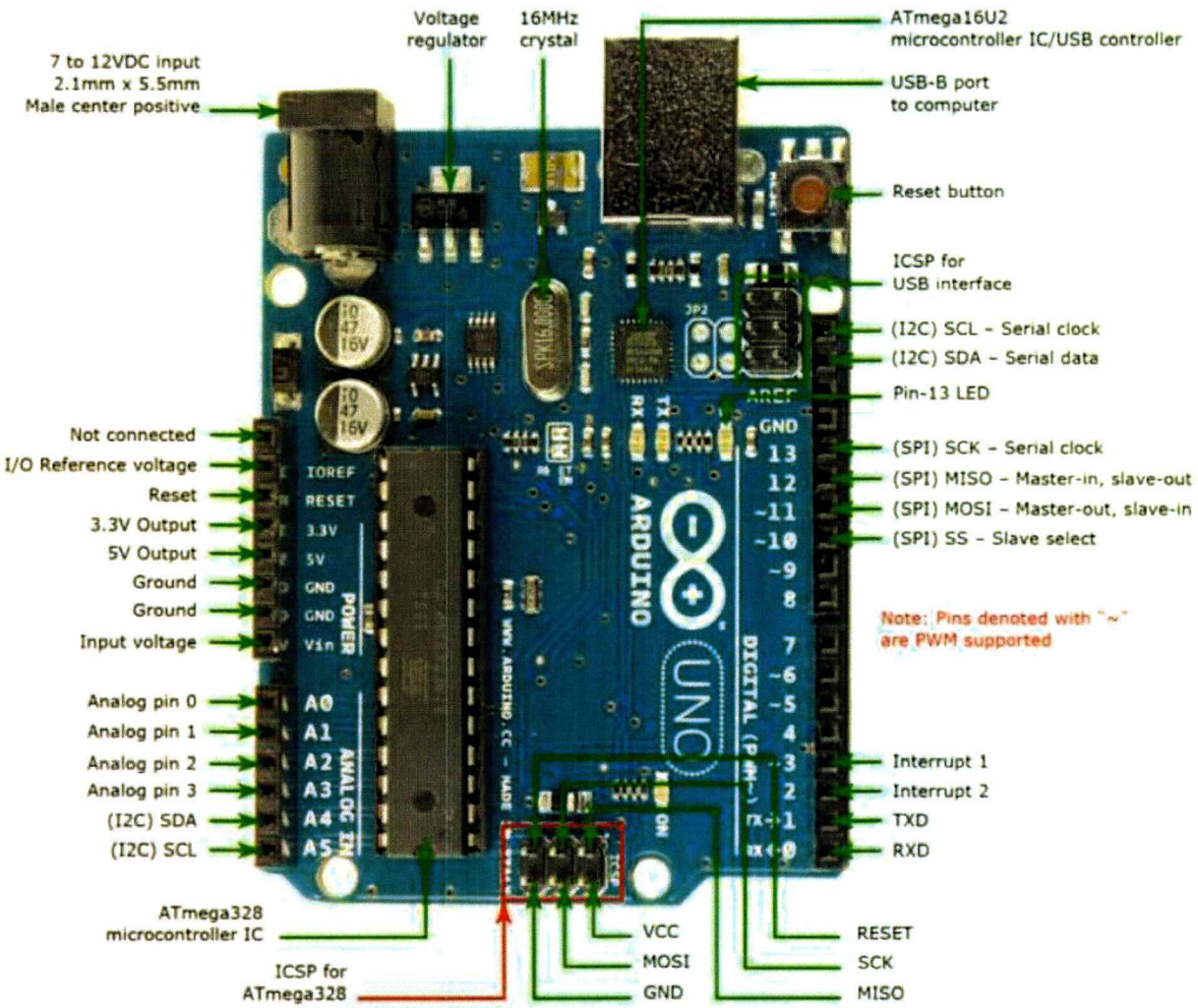



**FIGURE 3.3 PIN DIAGRAM OF ARDUINO UNO.**

# 4. DESIGN AND IMPLEMENTATION

## 4.1 CIRCUIT DIAGRAM.

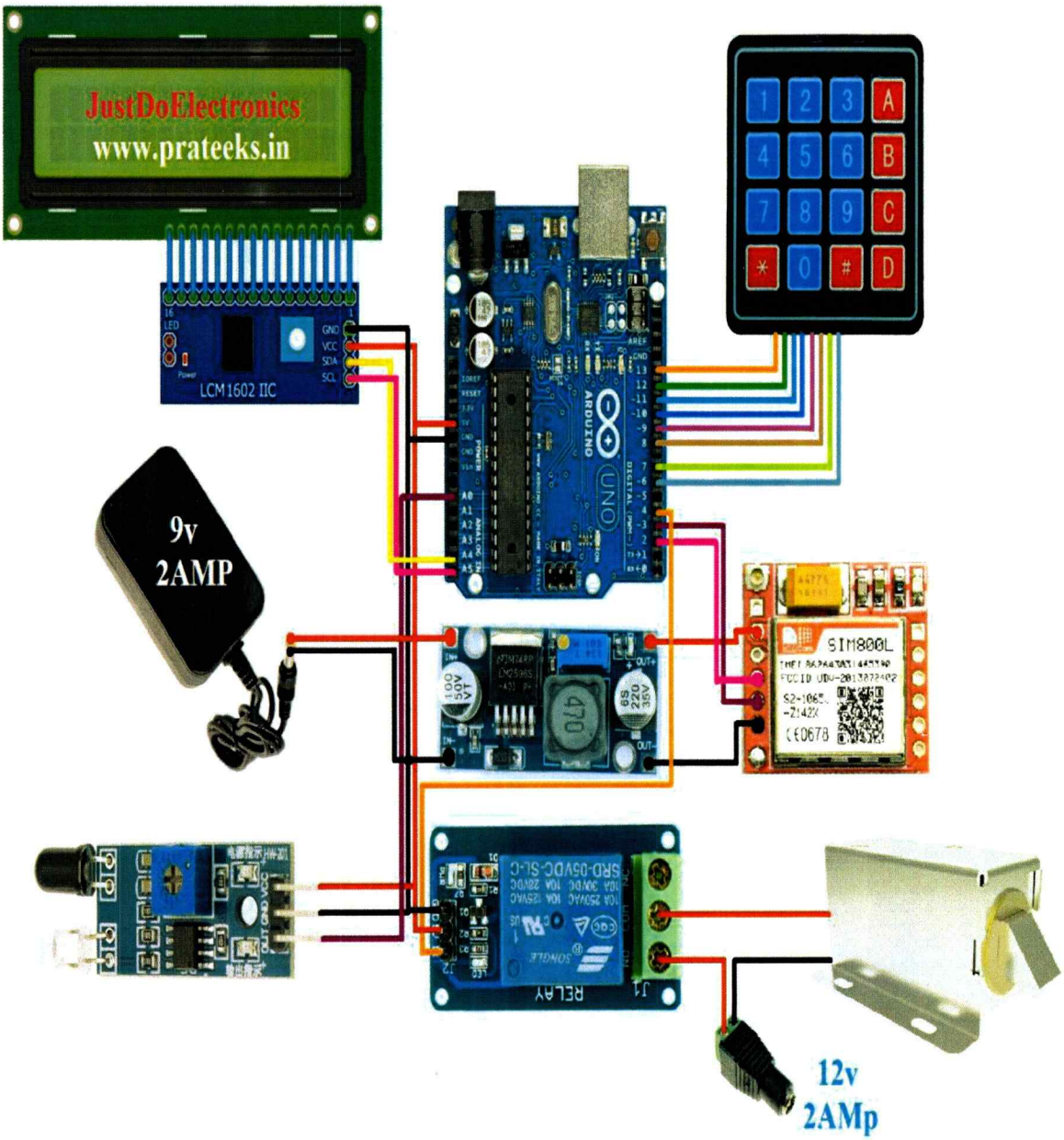



**Figure 4.1 Circuit diagram of the system.**

## 4.2 PROGRAMM ASSEMBLY LANGUAGE.

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Keypad.h>
#define relay 4
#define red 16
#define green 15
const byte ROWS = 4;
const byte COLS = 4;
char hexaKeys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};
byte rowPins[ROWS] = {13, 12, 11, 10};
byte colPins[COLS] = {9, 8, 7, 6};
Keypad customKeypad = Keypad ( makeKeymap(hexaKeys), rowPins, colPins, ROWS,
COLS);
LiquidCrystal_I2C lcd(0x27, 16, 2);
SoftwareSerial sim800l(3, 2);
int irsensor = A0;
int otp;
String otpstring = "";
int i = 0;
void setup()
{
```

```
 pinMode(irsensor, INPUT_PULLUP);
  sim800l.begin(4800);
  Serial.begin(115200);
  lcd.init();
  lcd.backlight();
  Serial.print("Welcome to SIM800L Project");
  sim800l.println("AT");
  updateSerial();
  pinMode(relay, OUTPUT);
  pinMode(red, INPUT);
  pinMode(green, INPUT);
  digitalWrite(relay, LOW);
  delay(500);
  sim800l.println("AT+CSQ");
  updateSerial();
  delay(1000);
}
void updateSerial()
{
  delay(500);
  while (Serial.available())
{
  sim800l.write(Serial.read());
  }
  while (sim800l.available()) {
    Serial.write(sim800l.read());
  }
}
void loop()
```

```
{
 lcd.setCursor(0, 0);
 lcd.print("   OTP Based");
 lcd.setCursor(0, 1);
 lcd.print("   Door Lock");
 if (digitalRead(irsensor) == LOW)
 {
  otp = random (2000, 9999);
  otpstring = String(otp);
  Serial.println(otpstring);
  while (digitalRead(irsensor) == LOW) {}
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print (" OTP Sent to");
  lcd.setCursor(0, 1);
   lcd.print (" Your Mobile");
  Serial.print("OTP is ");
  Delay (100);
  Serial.println(otpstring);
  Delay (100);
  SendSMS();
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Enter OTP :");
  getotp();
 }
}
void getotp()
{
```

```
String y = "";
 int a = y.length();
 while (a < 4)
 {
 char customKey = customKeypad.getKey();
  if (customKey) {
   lcd.setCursor(0, 1);
     y = y + customKey;
     lcd.print(y);
     a = y.length();
   }
 }
 Serial.print("Entered OTP is ");
 Serial.println(y);
 if (otpstring == y)
 {
   lcd.setCursor(0, 0);
   lcd.print("Access Granted");
   lcd.setCursor(0, 1);
   lcd.print("Door Opening");
   digitalWrite(relay, HIGH);
   digitalWrite(red, HIGH);
   digitalWrite(green, LOW);
   delay(5000);
   digitalWrite(relay, LOW);
   digitalWrite(red, LOW);
   digitalWrite(green, HIGH);
 }
 else
```

```
  {
   lcd.setCursor(0, 0);
   lcd.print("Access Failed");
   lcd.setCursor(0, 1);
   lcd.print("Try Again !!!");
   delay(3000);
  }
}
void SendSMS()
{
 Serial.println("Sending SMS...");
 sim800l.print("AT+CMGF=1\r");
 delay(100);
 sim800l.print ("AT+CSMP=17,167,0,0\r");
 delay(500);
 sim800l.print("AT+CMGS=\"+916355675571\"\r");
 delay(500);
 sim800l.print("Your OTP is " + otpstring + " Just Type OTP And Unlock The Door");
 delay(500);
 sim800l.print((char)26);
 delay(500);
 sim800l.println();
 Serial.println("Text Sent.");
 delay(500)
```

# 5. RESULTS AND DISCUSSION.

The proposed framework improved the ease of use and high unwavering quality of the computerized lock framework utilizing IOT. The advanced lock framework assumes a critical part, to give the security and lessen the HR in the brilliant home and building mechanization situation. The proposed strategy is executed the computerized lock framework, to guarantee the security, for an approved and the visitor client. We tried the security viewpoints in the distinctive climate. It is decreased the human labour, and furthermore it is given greater security, for the brilliant home and building mechanization applications

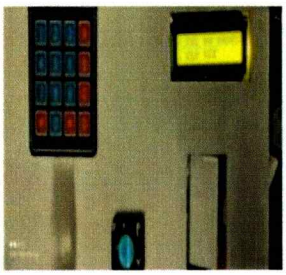


FIGURE 5.1 OTP MATCH.

FIGURE 5.2 ACCESS GRANTED.

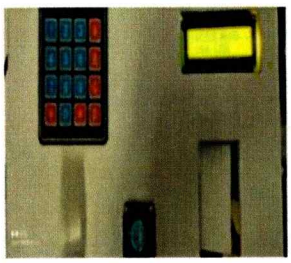


FIGURE 5.3 ACCESS DENIED.

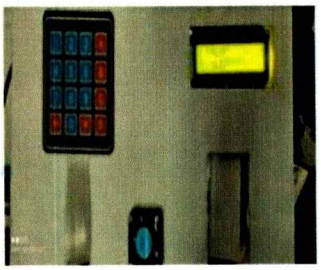


FIGURE 5.4 OPT MISMATCH.

# 6.FUTURE SCOPE

The above proposed system can have a large number of applications due to its practicality and its security aspect. Some of them are:

- It can be used for doors at Home and Offices.
- It can be used for Industrial doors.
- It can be used for high security Bank vault doors. Practically any place where remote controlling is required. For future scope, the device can be paired with a CCTV module to enhance the security.

# 7. CONCLUSION

The proposed framework improved the ease of use and high unwavering quality of the advanced lock framework utilizing IOT. The computerized lock framework assumes a critical part, to give the security and decrease the HR in the shrewd home and building robotization situation. The proposed technique is executed the advanced the proposed framework upgraded the convenience and high unwavering quality of the computerized lock framework, to guarantee the wellbeing, for an approved and the visitor client. The tried security viewpoints are in various climate. It is diminished the human labour, and furthermore it is given greater security, for the savvy home and building robotization applications. The proposed framework improved the convenience and high unwavering quality of the computerized lock framework utilizing IOT. The computerized lock framework assumes a huge part, to give the security and decrease the HR in the brilliant home and building computerization situation. The proposed strategy is executed the computerized lock framework, to guarantee the security, for an approved and the visitor client. We tried the security angles in the diverse climate. It is decreased the human labour, and furthermore it is given greater security, for the shrewd home and building robotization applications.

# 8. REFRENCES

[1] Mohammed, S.A., & Alkeelani, A.H. (2019). Locker Security System Using Keypad and RFID. 2019 International Conference of Computer Science and Renewable Energies (ICCSRE), 1-5.

[2] Shruti Jalapur, Afsha Maniya, "DOOR LOCK SYSTEM USING CRYPTOGRAPHIC ALGORITHM BASED ONIOT", IJMTER Volume 04, Issue 2, [February– 2017] ISSN(Online):2349–9745.

[3] Muhammad Ahtsham, H. Yan, U. Ali, "IOT Based Door Lock Surveillance System Using Cryptographic Algorithms", IJCMES 2017 Special Issue-1ISSN:2455- 5304.

[4] M. A. Hossain, N. Hossain, Afridi Shahid, S. M. S. Rahman "Security Solution of RFID Card Through Cryptography", International Conference on Explorations and Innovations in Engineering and Technology , 2016.

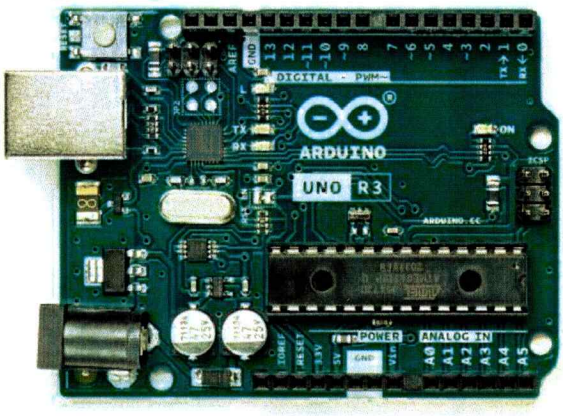
[5] Pradnya R. Nehete, Kantilal P. Rane A Paper on OTP Based Door Lock Security System , International Journal For Emerging Trends in Engineering and Management Research (IJETEMR) , Volume II, Issue II -21st June 2016 (ISSN NO: 2455-7773) .

[6] Kishwar Shafin,Kazi Lutful Kabir and Nazmul Hasan,"Development of an RFID based access control system in the context of Bangladesh", IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems,pp.1-5.

[7] Zaghloul, Mohamed Saad. "GSM-GPRS Arduino Shield (GS-001) with SIM 900 chip module in wireless data transmission system for data acquisition and control of power induction furnace." International Journal of Scientific & Engineering Research 5, no. 4 (2014): 776.

[8] Yu-Chih Huang; "Secure Access Control Scheme of RFID System Application", Fifth International Conference on Information Assurance and Security, China, 2009

# 9. APPENDIX




**Description**

The Arduino UNO R3 is the perfect board to get familiar with electronics and coding. This versatile microcontroller is equipped with the well-known ATmega328P and the ATMega 16U2 Processor.

This board will give you a great first experience within the world of Arduino.

**Target areas:**

Maker, introduction, industries.

- **ATMega328P** Processor
  - **Memory**
    - AVR CPU at up to 16 MHz
    - 32KB Flash
    - 2KB SRAM
    - 1KB EEPROM
  - **Security**
    - Power On Reset (POR)
    - Brown Out Detection (BOD)
  - **Peripherals**
    - 2x 8-bit Timer/Counter with a dedicated period register and compare channels
    - 1x 16-bit Timer/Counter with a dedicated period register, input capture and compare channels
    - 1x USART with fractional baud rate generator and start-of-frame detection
    - 1x controller/peripheral Serial Peripheral Interface (SPI)
    - 1x Dual mode controller/peripheral I2C
    - 1x Analog Comparator (AC) with a scalable reference input
    - Watchdog Timer with separate on-chip oscillator
    - Six PWM channels
    - Interrupt and wake-up on pin change
  - **ATMega16U2 Processor**
    - 8-bit AVR® RISC-based microcontroller

**Memory**

16 KB ISP Flash
512B EEPROM 512B SRAM
debugWIRE interface for on-chip debugging and programming

**Power**

2.7-5.5 volts

CONTENTS

# 1 The Board

## 1.1 Application Examples

The UNO board is the flagship product of Arduino. Regardless if you are new to the world of electronics or will use the UNO as a tool for education purposes or industry-related tasks.

**First entry to electronics:** If this is your first project within coding and electronics, get started with our most used and documented board; Arduino UNO. It is equipped with the well-known ATmega328P processor, 14 digital input/output pins, 6 analog inputs, USB connections, ICSP header and reset button. This board includes everything you will need for a great first experience with Arduino.

**Industry-standard development board:** Using the Arduino UNO board in industries, there are a range of companies using the UNO board as the brain for their PLC's.

**Education purposes:** Although the UNO board has been with us for about ten years, it is still widely used for various education purposes and scientific projects. The board's high standard and top quality performance makes it a great resource to capture real time from sensors and to trigger complex laboratory equipment to mention a few examples.

## 1.2 Related Products

- Starter Kit
- Tinkerkit Braccio Robot

Example

# 2 Ratings

## 2.1 Recommended Operating Conditions

| Symbol | Description | Min | Max |
|---|---|---|---|
| | Conservative thermal limits for the whole board: | -40 °C (-40°F) | 85 °C ( 185°F) |

**NOTE:** In extreme temperatures, EEPROM, voltage regulator, and the crystal oscillator, might not work as expected due to the extreme temperature conditions

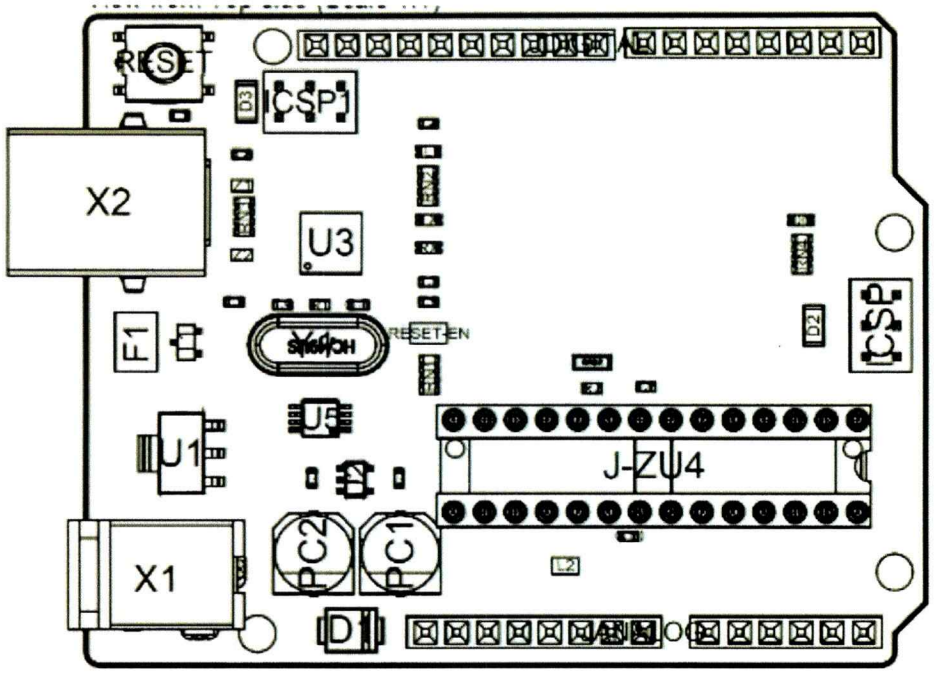
## 2.2 Power Consumption

| Symbol | Description | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VINMax | Maximum input voltage from VIN pad | 6 | - | 20 | V |
| VUSBMax | Maximum input voltage from USB connector | | - | 5.5 | V |
| PMax | Maximum Power Consumption | - | - | xx | mA |

# 3 Functional Overview

## 3.1 Board Topology

Top view



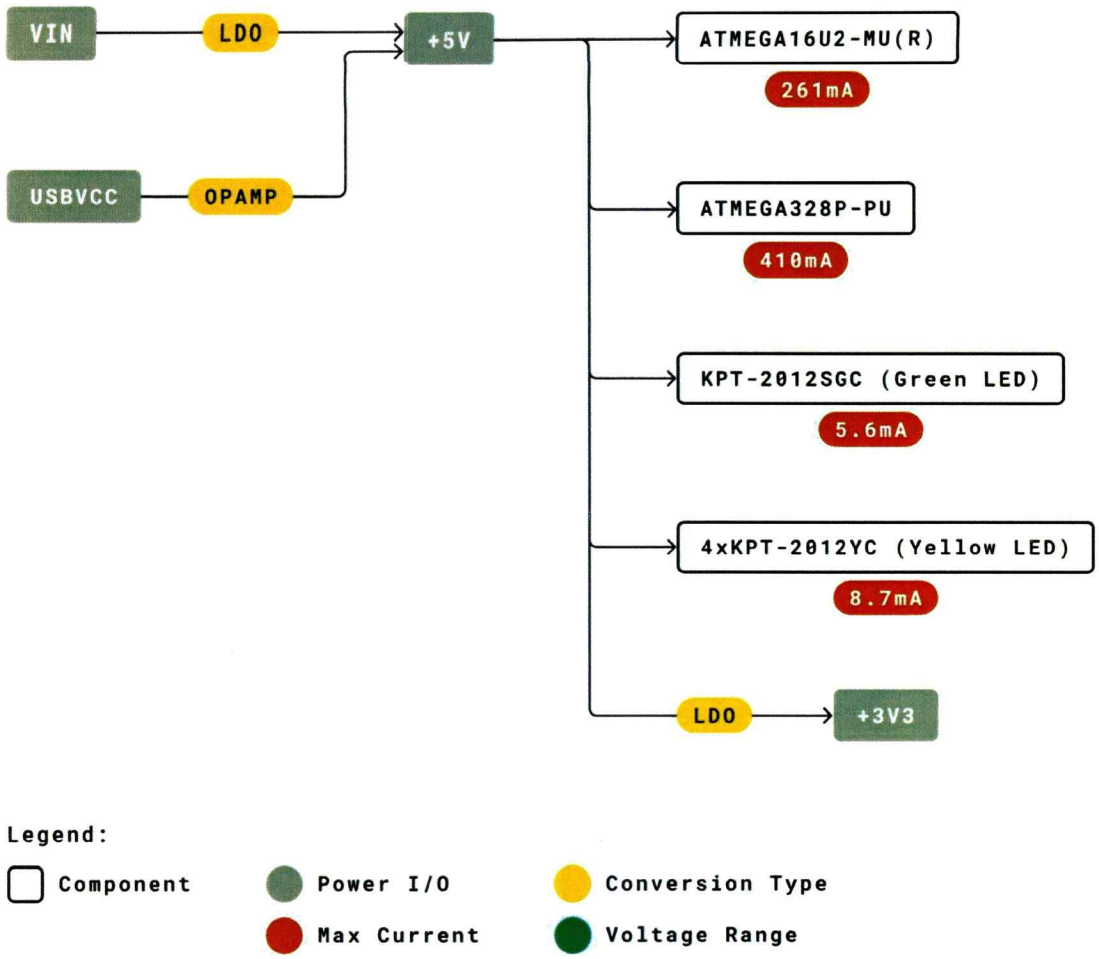

*Board topology*

| Ref. | Description | Ref. | Description |
|---|---|---|---|
| X1 | Power jack 2.1x5.5mm | U1 | SPX1117M3-L-5 Regulator |
| X2 | USB B Connector | U3 | ATMEGA16U2 Module |
| PC1 | EEE-1EA470WP 25V SMD Capacitor | U5 | LMV358LIST-A.9 IC |
| PC2 | EEE-1EA470WP 25V SMD Capacitor | F1 | Chip Capacitor, High Density |
| D1 | CGRA4007-G Rectifier | ICSP | Pin header connector (through hole 6) |
| J-ZU4 | ATMEGA328P Module | ICSP1 | Pin header connector (through hole 6) |
| Y1 | ECS-160-20-4X-DU Oscillator | | |

## 3.2 Processor

The Main Processor is a ATmega328P running at up tp 20 MHz. Most of its pins are connected to the external headers, however some are reserved for internal communication with the USB Bridge coprocessor.

### 3.3 Power Tree




*Power tree*

## 4 Board Operation

### 4.1 Getting Started - IDE

If you want to program your Arduino UNO while offline you need to install the Arduino Desktop IDE [1] To connect the Arduino UNO to your computer, you'll need a Micro-B USB cable. This also provides power to the board, as indicated by the LED.

### 4.2 Getting Started - Arduino Web Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Web Editor [2], by just installing a simple plugin.

The Arduino Web Editor is hosted online, therefore it will always be up-to-date with the latest features and support for all boards. Follow **[3]** to start coding on the browser and upload your sketches onto your board.

### 4.3 Getting Started - Arduino IoT Cloud

All Arduino IoT enabled products are supported on Arduino IoT Cloud which allows you to Log, graph and analyze sensor data, trigger events, and automate your home or business.

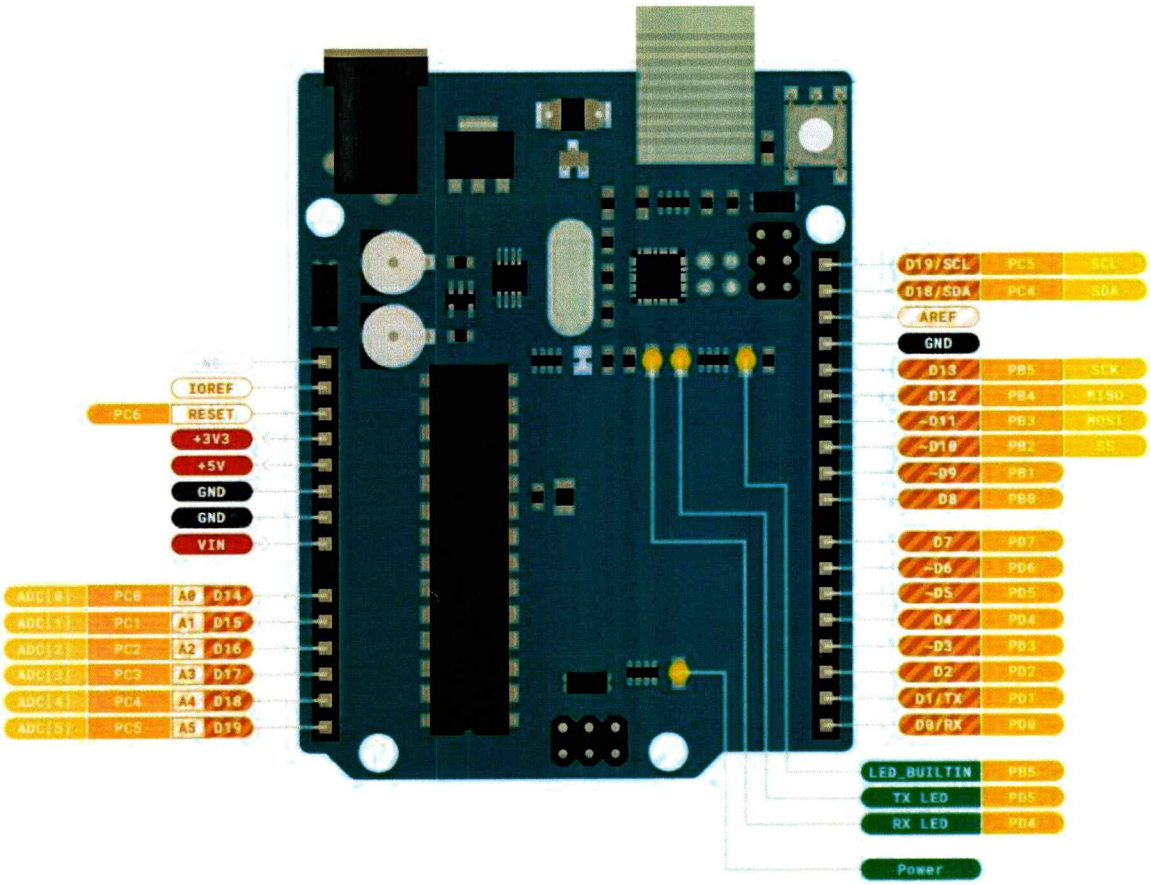
### 4.4 Sample Sketches

Sample sketches for the Arduino XXX can be found either in the "Examples" menu in the Arduino IDE or in the "Documentation" section of the Arduino Pro website [4]

### 4.5 Online Resources

Now that you have gone through the basics of what you can do with the board you can explore the endless possibilities it provides by checking exciting projects on ProjectHub **[5]**, the Arduino Library Reference **[6]** and the online store **[7]** where you will be able to complement your board with sensors, actuators and more

## 5 Connector Pinouts




*Pinout*

### 5.1 JANALOG

| Pin | Function | Type | Description |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | NC | NC | Not connected |
| 2 | IOREF | IOREF | Reference for digital logic V - connected to 5V |
| 3 | Reset | Reset | Reset |
| 4 | +3V3 | Power | +3V3 Power Rail |
| 5 | +5V | Power | +5V Power Rail |
| 6 | GND | Power | Ground |
| 7 | GND | Power | Ground |
| 8 | VIN | Power | Voltage Input |
| 9 | A0 | Analog/GPIO | Analog input 0 /GPIO |
| 10 | A1 | Analog/GPIO | Analog input 1 /GPIO |
| 11 | A2 | Analog/GPIO | Analog input 2 /GPIO |
| 12 | A3 | Analog/GPIO | Analog input 3 /GPIO |
| 13 | A4/SDA | Analog input/I2C | Analog input 4/I2C Data line |
| 14 | A5/SCL | Analog input/I2C | Analog input 5/I2C Clock line |

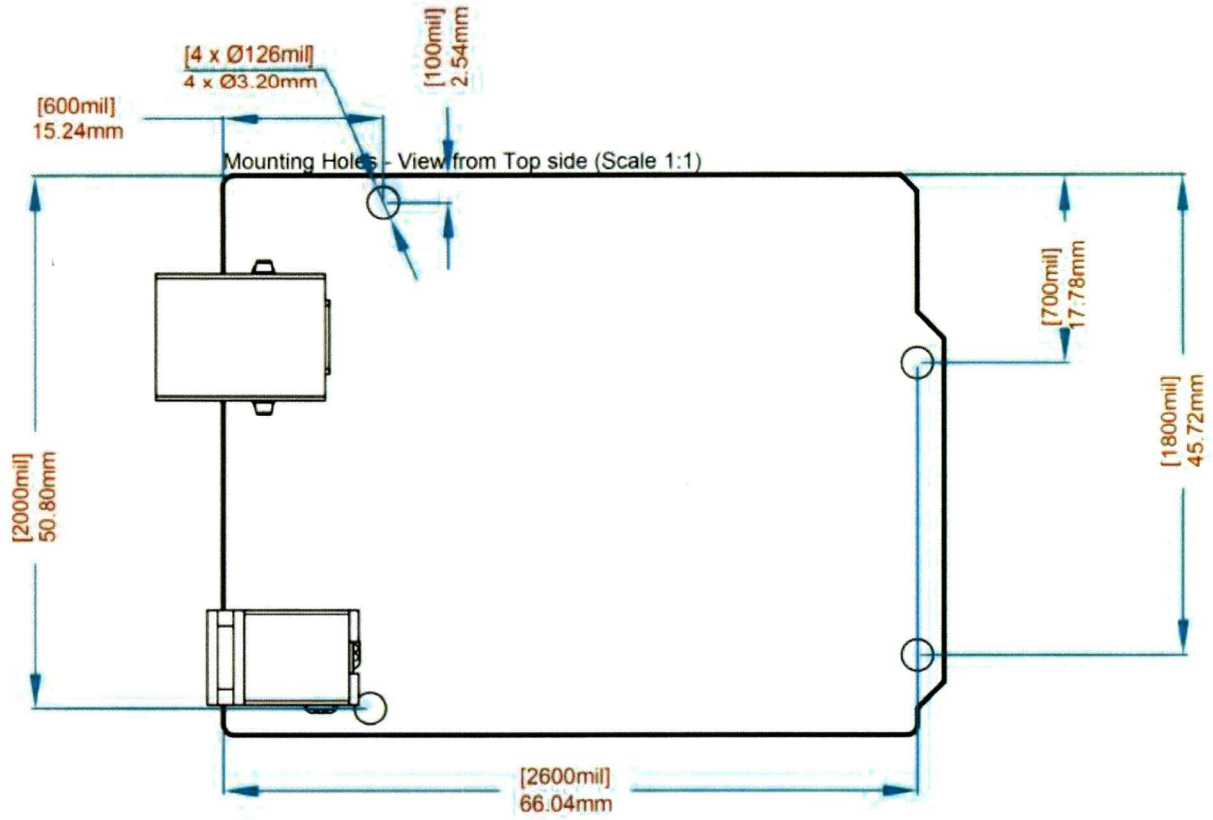
### 5.2 JDIGITAL

| Pin | Function | Type | Description |
|---|---|---|---|
| 1 | D0 | Digital/GPIO | Digital pin 0/GPIO |
| 2 | D1 | Digital/GPIO | Digital pin 1/GPIO |
| 3 | D2 | Digital/GPIO | Digital pin 2/GPIO |
| 4 | D3 | Digital/GPIO | Digital pin 3/GPIO |
| 5 | D4 | Digital/GPIO | Digital pin 4/GPIO |
| 6 | D5 | Digital/GPIO | Digital pin 5/GPIO |
| 7 | D6 | Digital/GPIO | Digital pin 6/GPIO |
| 8 | D7 | Digital/GPIO | Digital pin 7/GPIO |
| 9 | D8 | Digital/GPIO | Digital pin 8/GPIO |
| 10 | D9 | Digital/GPIO | Digital pin 9/GPIO |
| 11 | SS | Digital | SPI Chip Select |
| 12 | MOSI | Digital | SPI1 Main Out Secondary In |
| 13 | MISO | Digital | SPI Main In Secondary Out |
| 14 | SCK | Digital | SPI serial clock output |
| 15 | GND | Power | Ground |
| 16 | AREF | Digital | Analog reference voltage |
| 17 | A4/SD4 | Digital | Analog input 4/I2C Data line (duplicated) |

| | | | |
|---|---|---|---|
| 18 | A5/SD5 | Digital | Analog input 5/I2C Clock line (duplicated) |

## 5.3 Mechanical Information

## 5.4 Board Outline & Mounting Holes




*Board outline*

# 6 Certifications

## 6.1 Declaration of Conformity CE DoC (EU)

We declare under our sole responsibility that the products above are in conformity with the essential requirements of the following EU Directives and therefore qualify for free movement within markets comprising the European Union (EU) and European Economic Area (EEA).

| | |
|---|---|
| **ROHS 2 Directive 2011/65/EU** | |
| Conforms to: | EN50581:2012 |
| **Directive 2014/35/EU. (LVD)** | |
| Conforms to: | EN 60950-1:2006/A11:2009/A1:2010/A12:2011/AC:2011 |
| **Directive 2004/40/EC & 2008/46/EC & 2013/35/EU, EMF** | |
| Conforms to: | EN 62311:2008 |

### 6.2 Declaration of Conformity to EU RoHS & REACH 211 01/19/2021

Arduino boards are in compliance with RoHS 2 Directive 2011/65/EU of the European Parliament and RoHS 3 Directive 2015/863/EU of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

| Substance | Maximum limit (ppm) |
|---|---|
| Lead (Pb) | 1000 |
| Cadmium (Cd) | 100 |
| Mercury (Hg) | 1000 |
| Hexavalent Chromium (Cr6+) | 1000 |
| Poly Brominated Biphenyls (PBB) | 1000 |
| Poly Brominated Diphenyl ethers (PBDE) | 1000 |
| Bis(2-Ethylhexyl} phthalate (DEHP) | 1000 |
| Benzyl butyl phthalate (BBP) | 1000 |
| Dibutyl phthalate (DBP) | 1000 |
| Diisobutyl phthalate (DIBP) | 1000 |

Exemptions: No exemptions are claimed.

Arduino Boards are fully compliant with the related requirements of European Union Regulation (EC) 1907 /2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). We declare none of the SVHCs (https://echa.europa.eu/web/guest/candidate-list-table), the Candidate List of Substances of Very High Concern for authorization currently released by ECHA, is present in all products (and also package) in quantities totaling in a concentration equal or above 0.1%. To the best of our knowledge, we also declare that our products do not contain any of the substances listed on the "Authorization List" (Annex XIV of the REACH regulations) and Substances of Very High Concern (SVHC) in any significant amounts as specified by the Annex XVII of Candidate list published by ECHA (European Chemical Agency) 1907 /2006/EC.

### 6.3 Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations with regards to laws and regulations regarding Conflict Minerals, specifically the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502. Arduino does not directly source or process conflict minerals such as Tin, Tantalum, Tungsten, or Gold. Conflict minerals are contained in our products in the form of solder, or as a component in metal alloys. As part of our reasonable due diligence Arduino has contacted component suppliers within our supply chain to verify their continued compliance with the regulations. Based on the information received thus far we declare that our products contain Conflict Minerals sourced from conflict-free areas.

## 7 FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference

(2) this device must accept any interference received, including interference that may cause undesired operation.

**FCC RF Radiation Exposure Statement:**

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

English: User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both. This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference

(2) this device must accept any interference, including interference that may cause undesired operation of thedevice.

French: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l' appareil nedoit pas produire de brouillage

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptibled'en compromettre le fonctionnement.

**IC SAR Warning:**

English This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

French: Lors de l' installation et de l' exploitation de ce dispositif, la distance entre le radiateur et le corps est d 'au moins 20 cm.

**Important:** The operating temperature of the EUT can't exceed 85°C and shouldn't be lower than -40°C.

*Hereby, Arduino S.r.l. declares that this product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU. This product is allowed to be used in* all EU member states.

## 8 Company Information

| **Company name** | **Arduino S.r.l** |
|---|---|
| Company Address | Via Andrea Appiani 25 20900 MONZA Italy |

## 9 Reference Documentation

| **Reference** | **Link** |
|---|---|
| Arduino IDE (Desktop) | https://www.arduino.cc/en/Main/Software |
| Arduino IDE (Cloud) | https://create.arduino.cc/editor |
| Cloud IDE Getting Started | https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduinoweb-editor-4b3e4a |
| Arduino Pro Website | https://www.arduino.cc/pro |
| Project Hub | https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending |
| Library Reference | https://www.arduino.cc/reference/en/ |
| Online Store | https://store.arduino.cc/ |

## 10 Revision History

| **Date** | **Revision** | **Changes** |
|---|---|---|
| xx/06/2021 | 1 | Datasheet release |

A PROJECT REPORT

ON

# "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Submitted in partial fulfilment of the requirement of degree of

**Master of Science in Physics (Electronics)**

Submitted by


NAME :- **PRIYA RAMAKANT PATIL**

EXAM SEAT NO. :- **4140749**


UNDER THE GUIDANCE OF

**DR. SAPNA B. JADHAV**

&

**Prof. UTKARSHA A. SAVE**


DEPARTMENT OF PHYSICS

SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404


UNIVERSITY OF MUMBAI

2022-2023

**DEPARTMENT OF PHYSICS**

**SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404**

# CERTIFICATE

This is to certify that it is a confide record of project work entitled

## "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Carried out by

**Miss. PRIYA RAMAKANT PATIL [4140749]**

Of MSc. **Physics** Part II Sem-IV

In partial fulfilment of the requirement for the degree of **Master of Science in Physics (Electronics)** offered by Mumbai university of Mumbai is an authentic piece of work carried out by her under my guidance and supervision. To the best of my knowledge, the matter embodied in this report has not been submitted to any other university for the award of degree.

17/07/23

**External Examiner**

14/07/23

**Dr.Sapna B. Jadhav**

(Project Guide)

S. D. APTE COMM. & MEHTA SCIENCE COLLEGE * PALGHAR * DEPT. OF PHYSICS

**Professor Bhimrao Sakhare**

(Head of Department)

# DECLARATION

I hereby declare that

a) The written submission represents my ideas in my own words.

b) Wherever other's ideas or words have been included I have cited and given reference to the original sources.

c) I have adhered to all principles of academic honesty and have not misrepresented, fabricated or falsified any ideas, data or source in my submission.

d) I understand that any violation of above will be cause for disciplinary action by the institute and can also evoke penal action from other sources which have not been properly cited or from whom proper permission has not been taken when needed.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

# ACKNOWLEDGEMENT

This successful implementation and progressing of my project synopsis for the partial fulfilment of Degree of Master of Science in Physics (Electronics) would remain incomplete if I fail to express my sincere thanks and affectionate acknowledgement to certain people who had given their valuable time apart from their regular schedule and helping me for completion of this project work.

First of all, I am grateful to our project guide **Dr. Sapna B. Jadhav**, Professor in Physics Department, S.D.S.M. College, Palghar for thorough guidance and suggestions.

I express my deep gratitude to Assistance Professor **Mrs. Utkarsha A. Save** for guidance and valuable suggestions throughout this project work.

I am grateful to Professor **Mr. Bhimrav Sakhare**, H.O.D., Physics Department, S.D.S.M. College, Palghar for his valuable guidance.

I express my sincere thanks to **Principal** and **Vice Principal**, S.D.S.M. college, Palghar for permitting me to carry out project work in the institute.

Last but not the least, I would also like to thank my classmates and family who were directly and indirectly involved in the work co-ordination, financial co-operation and encouragement for completion of my study.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

A PROJECT REPORT

ON

# "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Submitted in partial fulfilment of the requirement of degree of

**Master of Science in Physics (Electronics)**

Submitted by


NAME :- **PRIYA RAMAKANT PATIL**

EXAM SEAT NO. :- **4140749**


UNDER THE GUIDANCE OF

**DR. SAPNA B. JADHAV**

&

**Prof. UTKARSHA A. SAVE**


DEPARTMENT OF PHYSICS

SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404


UNIVERSITY OF MUMBAI

2022-2023

**DEPARTMENT OF PHYSICS**

**SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404**

# CERTIFICATE

This is to certify that it is a confide record of project work entitled

## "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Carried out by

**Miss. PRIYA RAMAKANT PATIL [4140749]**

Of MSc. **Physics** Part II Sem-IV

In partial fulfilment of the requirement for the degree of **Master of Science in Physics (Electronics)** offered by Mumbai university of Mumbai is an authentic piece of work carried out by her under my guidance and supervision. To the best of my knowledge, the matter embodied in this report has not been submitted to any other university for the award of degree.

17/07/23

**External Examiner**

14/07/23

**Dr.Sapna B. Jadhav**

(Project Guide)

S. D. APTE COMM. & MEHTA SCIENCE COLLEGE DEPT. OF PHYSICS PALGHAR

**Professor Bhimrao Sakhare**

(Head of Department)

# DECLARATION

I hereby declare that

a) The written submission represents my ideas in my own words.

b) Wherever other's ideas or words have been included I have cited and given reference to the original sources.

c) I have adhered to all principles of academic honesty and have not misrepresented, fabricated or falsified any ideas, data or source in my submission.

d) I understand that any violation of above will be cause for disciplinary action by the institute and can also evoke penal action from other sources which have not been properly cited or from whom proper permission has not been taken when needed.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

# ACKNOWLEDGEMENT

This successful implementation and progressing of my project synopsis for the partial fulfilment of Degree of Master of Science in Physics (Electronics) would remain incomplete if I fail to express my sincere thanks and affectionate acknowledgement to certain people who had given their valuable time apart from their regular schedule and helping me for completion of this project work.

First of all, I am grateful to our project guide **Dr. Sapna B. Jadhav**, Professor in Physics Department, S.D.S.M. College, Palghar for thorough guidance and suggestions.

I express my deep gratitude to Assistance Professor **Mrs. Utkarsha A. Save** for guidance and valuable suggestions throughout this project work.

I am grateful to Professor **Mr. Bhimrav Sakhare**, H.O.D., Physics Department, S.D.S.M. College, Palghar for his valuable guidance.

I express my sincere thanks to **Principal** and **Vice Principal**, S.D.S.M. college, Palghar for permitting me to carry out project work in the institute.

Last but not the least, I would also like to thank my classmates and family who were directly and indirectly involved in the work co-ordination, financial co-operation and encouragement for completion of my study.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

# ABSTRACT

Safety is a precaution taken to live our life to live in a better way. Safety is a main concern while considering automobiles too. Basically, our little carelessness has led to many accidents in roadways. The Gas leakage is one of the big problems with gas functioning vehicles like CNG (Compressed Natural Gas) buses, cars etc. To prevent that we are making system that detect CNG gas leakage in vehicles. To stop accidents associated with the gas leakage in vehicle I installed a gas leakage detection device.The system detects the leakage of the gas using a gas sensor and to alert the person about the gas leakage via alarm. This device should be fitted / installed inside the vehicle connected to the microcontroller . As the detection is done by the gas sensor, through the microcontroller the LED and buzzer are turned ON simultaneously and display message so that drive take proper precaution to avoid major accident. Also Bluetooth module is connected to it so driver get message on its phone .

The goal of this project was to build a system that can alert the driver in case of CNG gas leakage happen in vehicles.

# TABLE OF CONTENTS

A PROJECT REPORT

ON

# "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Submitted in partial fulfilment of the requirement of degree of

**Master of Science in Physics (Electronics)**

Submitted by


NAME :- **PRIYA RAMAKANT PATIL**

EXAM SEAT NO. :- **4140749**


UNDER THE GUIDANCE OF

**DR. SAPNA B. JADHAV**

&

**Prof. UTKARSHA A. SAVE**


DEPARTMENT OF PHYSICS

SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404

UNIVERSITY OF MUMBAI


2022-2023

**DEPARTMENT OF PHYSICS**

**SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404**

# CERTIFICATE

This is to certify that it is a confide record of project work entitled

## "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Carried out by

**Miss. PRIYA RAMAKANT PATIL [4140749]**

Of MSc. **Physics** Part II Sem-IV

In partial fulfilment of the requirement for the degree of **Master of Science in Physics (Electronics)** offered by Mumbai university of Mumbai is an authentic piece of work carried out by her under my guidance and supervision. To the best of my knowledge, the matter embodied in this report has not been submitted to any other university for the award of degree.

17/07/23

**External Examiner**

14/07/23

**Dr.Sapna B. Jadhav**

(Project Guide)

S. D. APTE COMM. & MEHTA SCIENCE COLLEGE * PALGHAR * DEPT. OF PHYSICS

**Professor Bhimrao Sakhare**

(Head of Department)

A PROJECT REPORT

ON

# "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Submitted in partial fulfilment of the requirement of degree of

**Master of Science in Physics (Electronics)**

Submitted by


NAME :- **PRIYA RAMAKANT PATIL**

EXAM SEAT NO. :- **4140749**


UNDER THE GUIDANCE OF

**DR. SAPNA B. JADHAV**

&

**Prof. UTKARSHA A. SAVE**


DEPARTMENT OF PHYSICS

SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404

UNIVERSITY OF MUMBAI


2022-2023

**DEPARTMENT OF PHYSICS**

**SONOPANT DANDEKAR ARTS V.S.APTE COMMERC AND M.H.MEHTA SCIENCE COLLEGE PALGHAR TAL-DIST PALGHAR-401404**

# CERTIFICATE

This is to certify that it is a confide record of project work entitled

## "AUTOMATIC ALARM BUZZER DURING CNG GAS LEAKAGE IN VEHICLES"

Carried out by

**Miss. PRIYA RAMAKANT PATIL [4140749]**

Of MSc. **Physics** Part II Sem-IV

In partial fulfilment of the requirement for the degree of **Master of Science in Physics (Electronics)** offered by Mumbai university of Mumbai is an authentic piece of work carried out by her under my guidance and supervision. To the best of my knowledge, the matter embodied in this report has not been submitted to any other university for the award of degree.

17/07/23

**External Examiner**

14/07/23

**Dr.Sapna B. Jadhav**

(Project Guide)

S. D. APTE COMM. & M.H. MEHTA SCIENCE COLLEGE DEPT. OF PHYSICS PALGHAR

**Professor Bhimrao Sakhare**

(Head of Department)

# DECLARATION

I hereby declare that

a) The written submission represents my ideas in my own words.

b) Wherever other's ideas or words have been included I have cited and given reference to the original sources.

c) I have adhered to all principles of academic honesty and have not misrepresented, fabricated or falsified any ideas, data or source in my submission.

d) I understand that any violation of above will be cause for disciplinary action by the institute and can also evoke penal action from other sources which have not been properly cited or from whom proper permission has not been taken when needed.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

# ACKNOWLEDGEMENT

This successful implementation and progressing of my project synopsis for the partial fulfilment of Degree of Master of Science in Physics (Electronics) would remain incomplete if I fail to express my sincere thanks and affectionate acknowledgement to certain people who had given their valuable time apart from their regular schedule and helping me for completion of this project work.

First of all, I am grateful to our project guide **Dr. Sapna B. Jadhav**, Professor in Physics Department, S.D.S.M. College, Palghar for thorough guidance and suggestions.

I express my deep gratitude to Assistance Professor **Mrs. Utkarsha A. Save** for guidance and valuable suggestions throughout this project work.

I am grateful to Professor **Mr. Bhimrav Sakhare**, H.O.D., Physics Department, S.D.S.M. College, Palghar for his valuable guidance.

I express my sincere thanks to **Principal** and **Vice Principal**, S.D.S.M. college, Palghar for permitting me to carry out project work in the institute.

Last but not the least, I would also like to thank my classmates and family who were directly and indirectly involved in the work co-ordination, financial co-operation and encouragement for completion of my study.

**Miss. PRIYA RAMAKANT PATIL**

**[4140749]**

# ABSTRACT

Safety is a precaution taken to live our life to live in a better way. Safety is a main concern while considering automobiles too. Basically, our little carelessness has led to many accidents in roadways. The Gas leakage is one of the big problems with gas functioning vehicles like CNG (Compressed Natural Gas) buses, cars etc. To prevent that we are making system that detect CNG gas leakage in vehicles. To stop accidents associated with the gas leakage in vehicle I installed a gas leakage detection device.The system detects the leakage of the gas using a gas sensor and to alert the person about the gas leakage via alarm. This device should be fitted / installed inside the vehicle connected to the microcontroller . As the detection is done by the gas sensor, through the microcontroller the LED and buzzer are turned ON simultaneously and display message so that drive take proper precaution to avoid major accident. Also Bluetooth module is connected to it so driver get message on its phone .

The goal of this project was to build a system that can alert the driver in case of CNG gas leakage happen in vehicles.

# TABLE OF CONTENTS

# LIST OF FIGURES

# CHAPTER 1 INTRODUCTION

## 1.1 MOTIVATION

Road accidents are increasing every day and various reasons are involved in it. Many people do lose their lives on the roads and it is very difficult to resolve this problem which affects almost everyone. There are several causes of road accidents.

In current days several accidents are happening due to Gas leakage tragedies and accidents have led to heavy losses over the years. So it is very important to detect any gas leakage and prevent any accidents. In gas functioning vehicles like CNG (Compressed natural gas) buses, cars, etc. gas leakage can be happens due to several reasons like overfilling the fuel tank ,improper fitting and gradual leakage with time. So best solution is to detect this leakage before happening any big accident. Thus this topic will be a lifesaving and effective too.

## 1.2 BACKGROUND

CNG is Compressed Natural Gas and can be used as an petrol alterative in vehicles. Now a days CNG gas functioning vehicles gaining popularity over other fuel types due to a host of advantages. CNG is good for the environment. It is cheaper than petrol and LPG so it saves money. Vehicles runs on both CNG and petrol so its option for petrol.

The background for CNG (Compressed Natural Gas) gas functioning vehicles involves understanding the use of CNG as an alternative fuel and its advantages in the transportation sector. Here are some key background points:

1. CNG as an Alternative Fuel: Compressed Natural Gas (CNG) is a gaseous fuel that is predominantly composed of methane. It is considered an alternative fuel to conventional gasoline and diesel, offering potential environmental and economic benefits

2. Environmental Benefits: CNG is known for its lower emissions compared to gasoline and diesel. It is considered a cleaner-burning fuel, contributing to improved air quality and reduced carbon footprint.

3. Cost-effectiveness: CNG can be cost-effective compared to traditional fossil fuels. In some regions, the price of CNG is often lower than gasoline or diesel, resulting in potential cost savings for vehicle owners and operators. Additionally, CNG vehicles may have lower maintenance costs due to cleaner combustion and reduced engine wear.

## 1.3 NEED OF THE PROJECT

The need for a project involving an automatic alarm buzzer in CNG gas functioning vehicles during leakage arises from several important factors:

1. Safety: CNG (Compressed Natural Gas) is a highly flammable and potentially hazardous fuel. In the event of a gas leakage, there is a significant risk of fire or explosion. An automatic alarm buzzer can provide an early warning system, allowing the driver and passengers to evacuate the vehicle and take appropriate safety measures.

2. Gas Detection: CNG gas leaks are often odorless and invisible. Without an alarm system, it can be challenging to detect leaks promptly. An automatic alarm buzzer integrated with a gas detection system can sense the presence of gas and trigger an alarm, ensuring the leakage is promptly identified.

3. Human Sensory Limitations: Humans may not be able to perceive small or slow gas leaks due to limitations in our senses. An automatic alarm system can overcome these limitations by utilizing sensitive gas sensors that can detect even minor gas leakages, providing an early warning signal before the situation worsens.

4. Prompt Response: Timely action is crucial during gas leakages to prevent potential accidents. An automatic alarm buzzer can alert the driver and occupants immediately, prompting them to

take quick action, such as turning off the vehicle's ignition, opening windows, and safely exiting the vehicle.

5. Compliance and Regulations: Many countries have stringent safety regulations in place for vehicles operating on CNG. An automatic alarm system can help vehicle owners comply with these regulations and ensure the safety of passengers and the general public.

the project aims to enhance safety, provide early warning of gas leaks, and reduce the risk of accidents, injuries, and property damage associated with CNG leakages.

### 1.4 KEYWORD

- 8051 Microcontroller (IC P89V51RD2)
- Gas Detector Sensor (MQ5)
- HC-05 Bluetooth Module
- Alarm Buzzer
- BC 547 Transistor
- IN 4007 Diode
- LM 7805 Voltage regulator
- LED

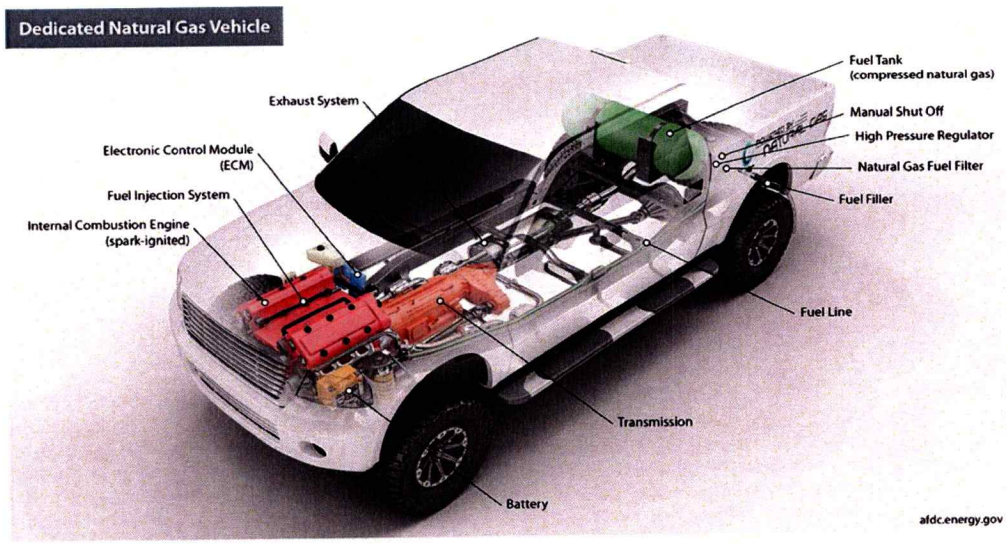



Figure 1.1 CNG Gas system in cars

# CHAPTER 2 LITERATURE REVIEW

A number of reviews on the subject of gas leakage detection techniques were used in the past.

### 2.1 LPG/CNG Gas Leakage Detection System with GSM Module

Alan M John1, Bhavesh Purbia2, Ankit Sharma3, Mrs. A.S Udapurkar4

Students, Department of Electrical Engineering, NBN Sinhgad School of Engineering, Savitribai Phule University, Pune, India.

The system detects the leakage of the LPG using a gas sensor and uses the GSM to alert the person about the gas leakage via SMS. When the concentration of LPG in air exceeds a certain level, the sensor senses the gas leakage and the output of the sensor goes LOW. The detection is done by the gas sensor, through the microcontroller the LED and buzzer are turned ON simultaneously. An alert is provided to the user, sending an SMS to the programmed mobile number.

### 2.2 Pal-Stefan Murvaya, Ioan Sileaa, 2008

They told in their survey on gas leak detection and localization techniques various ways to detect the gas leakage. They introduce some old or new technique to detect the gas. The proposed techniques in this paper are nontechnical methods, hardware based methods which include acoustic methods, optical methods and active methods. In their survey they told a wide variety of leak detecting techniques is available for gas pipelines. Some techniques have been improved since their first proposal and some new ones were designed as a result of advances in sensor manufacturing and computing power .Leak detection techniques in each category share some advantages and disadvantages. In proposed paper, they work on the classification of leak detection technologies. Most detection techniques rely on the measurement of a certain physical quantity or the manifestation of a certain physical phenomenon.

### 2.3.Vehicle Gas Leakage Detector

A. Che Soh, M.Sc.; M.K. Hassan, M.Eng.; and A.J. Ishak, M.Sc. Department of Electrical and Electronic Engineering, Faculty of Engineering, University Putra Malaysia.This paper presents the design of a Carbon Monoxide (CO) gas leakage detector in vehicles. The number of sudden death incidents due to excessive CO inhalation has recently increased.

Many cases are due to driver habits and awareness, for instance, air conditioning switches remain on while they are sleeping in the car. This habit is not a good practice because if there were gas leakage into the cabin, especially CO, the situation could result in sudden death. Basically the driver feels sleepy when excessive CO concentrations occur in the cabin. Based on that, a vehicle gas leakage detector system has been developed using a gas sensor and logic detector circuit. Subsequently, the signal from the sensor is fed to an 8-bit PIC16F84 microcontroller on-board system via appropriate interfacing devices, which will run on pre-programmed instructions.

### 2.4 LPG/CNG Gas Leakage Detection Based on Iot

Shivam Rana, Devansh Dubey, Saumya Kumar design a system. The main aim of our project is to detect LPG/CNG Gas leakage using gas sensor and notify the user with the help sending sms to alerts the people.In this paper we have put our main focus on safety. Gas leakage is detect by the system with the help of gas sensor via SMS. When the concentration of CNG in air increase to a certain level, then after the gas leakage system of the controller is detected and measured by the leakage detector in which many of the electrical devices are like LED, buzzer and microcontroller are fixed. And the notification is delivered to the user, notify through an SMS to the verified mobile number.

### 2.5 Gas leakage detection and alerting system using Arduino UNO

Syeda Bushra Shahewaz and Ch.Rajendra Prasad design a system. The presence of hazardous LPG gas leakage in a domestic, work place, also stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is usedto vibrate an alarm which is buzzer. Buzzer gives an audible sigh of the presence of LPG volume. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the LPG sensor senses gas leak from work place or home, sensor output goes to active low condition.

# CHAPTER 3 PROBLEM DEFINITION

## 3.1 Research Problem

"To develop an effective and reliable automatic alarm system that can accurately detect CNG gas leakage in CNG gas functioning vehicles, provide timely and accurate alerts to the vehicle occupants, and ensure proper evacuation and safety measures are taken to mitigate the risks associated with gas leaks."

This research problem encompasses several key areas of investigation:

1. Detection Technology: Research is needed to explore and identify the most suitable gas detection technology for CNG gas leakage detection in vehicles. This involves evaluating various gas sensors, their sensitivity, response time, and reliability in detecting CNG leaks.

2. Alarm System Integration: An alarm system that can integrate with the vehicle's electrical system and other safety features. This integration should allow for immediate and audible alerts when gas leakage is detected, ensuring that the alarm is easily perceptible to the occupants.

3. Sensor Placement and Coverage: Optimal sensor placement within the vehicle needs to be determined to ensure comprehensive coverage and accurate detection of gas leaks. Identify the key areas where gas sensors should be installed to maximize the detection capabilities of the system.

4. False Alarm Reduction: Research is needed to address false alarm triggers, such as environmental factors (e.g., temperature, humidity) or other gases commonly found in vehicle environments (e.g., exhaust fumes), and develop algorithms or filtering mechanisms to minimize false alarms.

This are the some key areas of research problem.

# CHAPTER 4 AIM AND OBJECTIVES

## 4.1Aim

The aim for an automatic alarm buzzer during CNG gas leakage in CNG gas functioning vehicles is to enhance safety by providing an early warning system that promptly detects gas leaks and alerts the vehicle occupants. The specific aims include:

1. The automatic alarm buzzer aims to detect CNG gas leakage as early as possible. The system aims to trigger an audible alarm that is loud and distinguishable to alert the vehicle occupants when a gas leak is detected.

3. The aim is to facilitate a quick response from the vehicle occupants upon hearing the alarm.

5. Also to mitigate the risks associated with CNG gas leaks. This includes reducing the likelihood of fire, explosion, or asphyxiation hazards, minimizing the potential for injuries, fatalities, and property damage.

## 4.2 Objectives

The objectives are as follows:

1. The main objective of this project is to design a system to detect CNG gas leakage in vehicles.

2.This project is to build a system that can prevent or minimize the cause of accidents happens due to CNG gas leakage.

3.It increased security in CNG gas functioning vehicles.

4.Also the main idea of this research is to create a simple and easy system that has high sensitivity and can sense the presence of CNG gas leakage in a vehicles.

## METHODOLOGY DIAGRAM

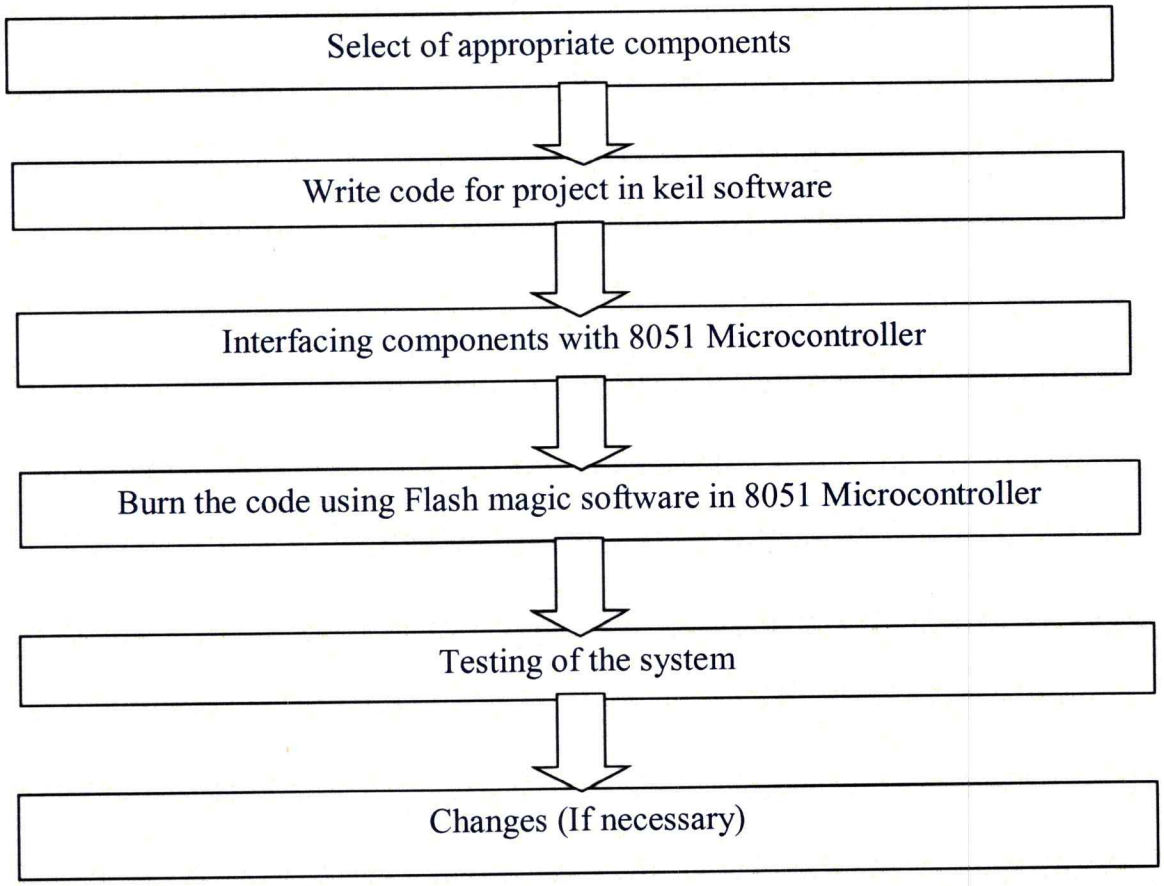



**Figure 5 : Methodology**

The methodology used for making the system as shown in above flow-chart. The detailed explanation of above chart is given below :

- Selection of appropriate components : In this stage of the project I have surveyed components available in market. Understand the specification of component from there datasheet and then select which components are suitable for this project.

- Write code for project in Keil software: write code for project in keil microvision 5 software using assembly C++ language.
- Interfacing components with 8051 microcontroller: Interfacing MQ-4 sensor,HC-05 bluetooth module,alarm buzzer,LED,16*2 LCD display with IC P89V51RD2 .Connect them properly.
- Burn the code: after connecting all the components, burn this written code using Flash magic software in 8051 microcontroller (IC P89V51RD2).
- Testing of the system: after completing the all connection test the system . If there is any problem then change the connection according to our requirement .

## 6.1.Block Diagram:

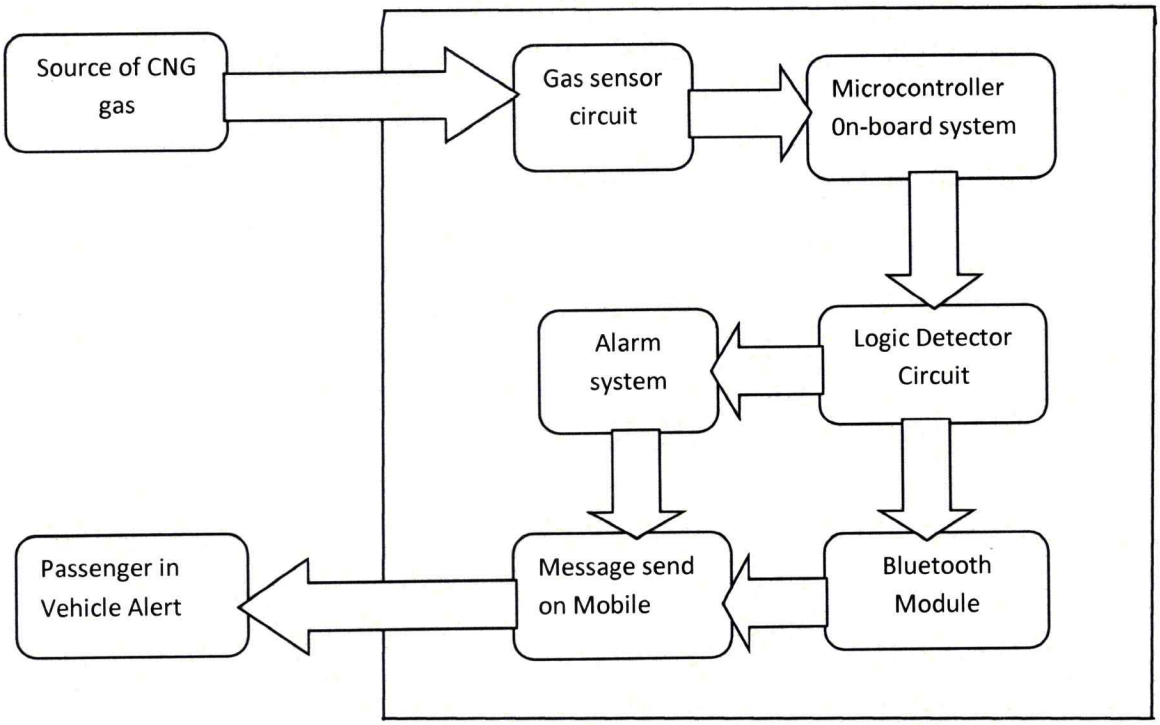



**Figure 6.1 Block Diagram of project**

Above figure shows the block diagram of my project . The system consist of hardware components which connected to each other. In this system source of CNG gas is my input. When CNG gas leakage happen it detected by gas sensor detector. It gives signal to 8051 microcontroller. Microcontroller is connected to logic detector circuit and logic detector circuit gives signal to alarm system. So at the time of CNG Gas leakage happens Output is display on 16*2 LCD display , alarm buzzer start , LED glow and with the help of Bluetooth module alert message is send on phone. So the passenger in vehicles are alert.

## 6.2 Component Diagram:

The main components requried for the project are MQ4 Gas Sensor , IC P89V51RD2, 16*2 LCD Display, LED indicator, Buzzer,and HC-05 Bluetooth Module.

Arrengment of this component is shows in Figure 6.2 .

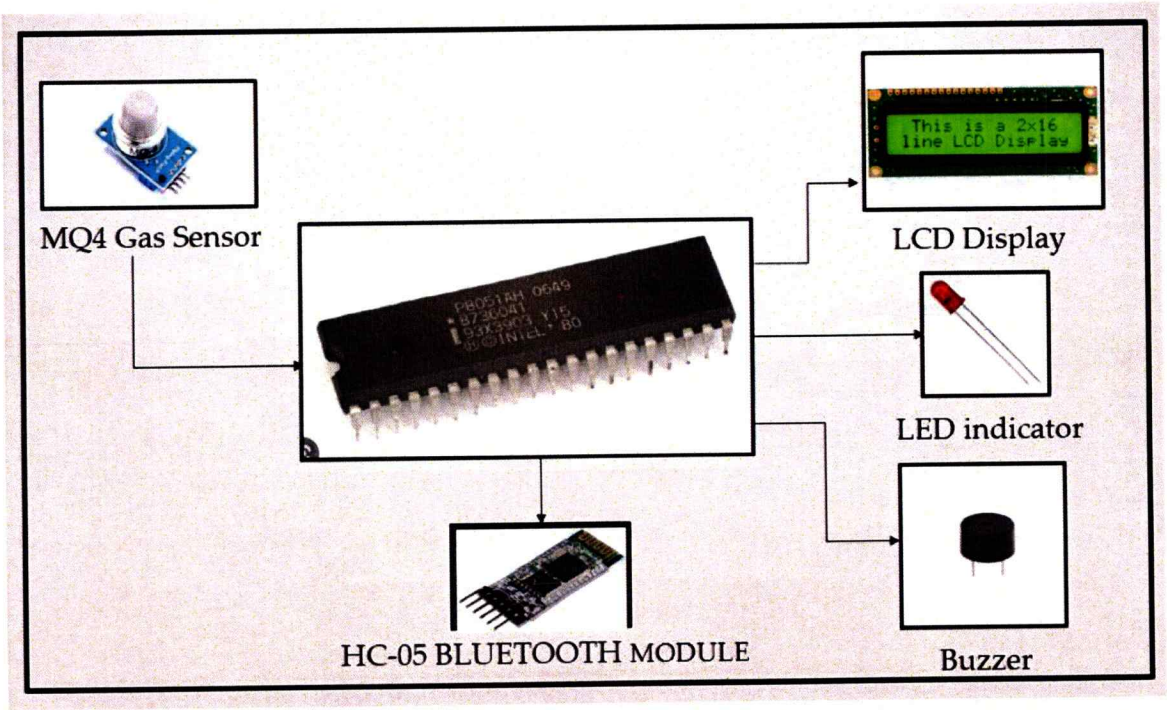



**Figure 6.2 Component Diagram of Project**

## 6.3 Flowchart of working of the system

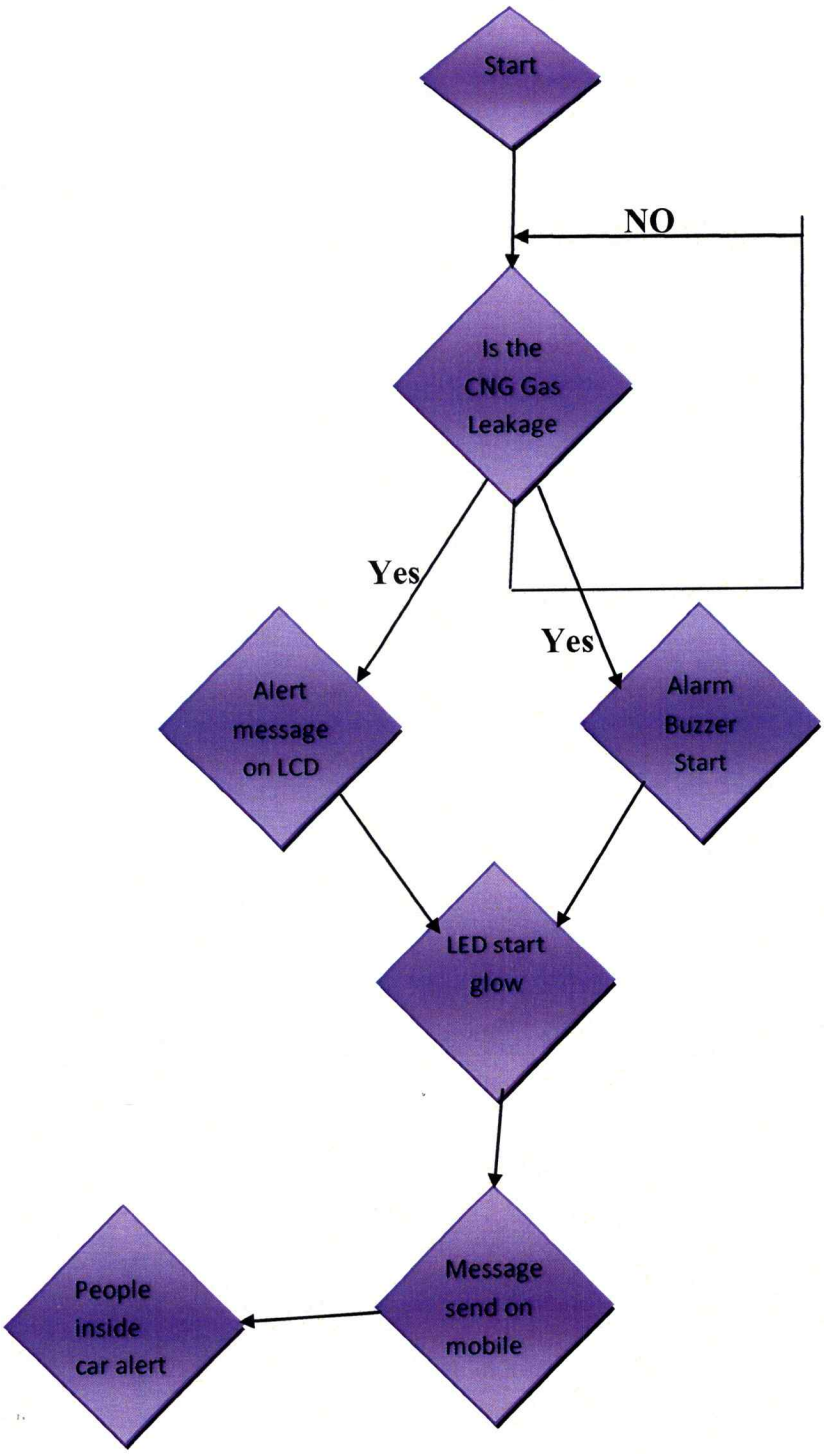



**Figure 6.3: Flowchart of Working of the system**

1. Start the system by switching it ON.
2. MQ-4 gas sensor detect if the CNG gas is leakage.
3. If the gas is leakage then Alert message is display on the 16*2 LCD display and buzzer start.
4. LED start glowing .
5. With the help of Bluetooth module the alert message is send on the mobile phone.
6. Passenger inside the vehicles are alert.
7. If gas is not leakage then nothing happen .

# CHAPTER 7
# INTERNAL CONNECTION OF 8051 MICROCONTROLLER

For working of the 8051 microcontroller we required the following circuit connection.

## 7.1 Voltage Regulator Circuit

In this project. I used 9 volt battery, as we know 8051 microcontroller required 5volt power Supply. So into we have to Converted 9 volt power supply into 5 volt power supply.

For that I used LM7805 voltage regulator.

For making Voltage regulator circuit following components required :-

- 9 Volt Battery
- IN 4007 Diode
- LM7805 voltage regulator
- LED (1 piece)
- 10 k resistor (1 piece)
- 104 pf Ceramic Capacitor (2 pieces)
- 100 uF Electrolytic capacitor. .(1 piece)

Circuit Diagram :-

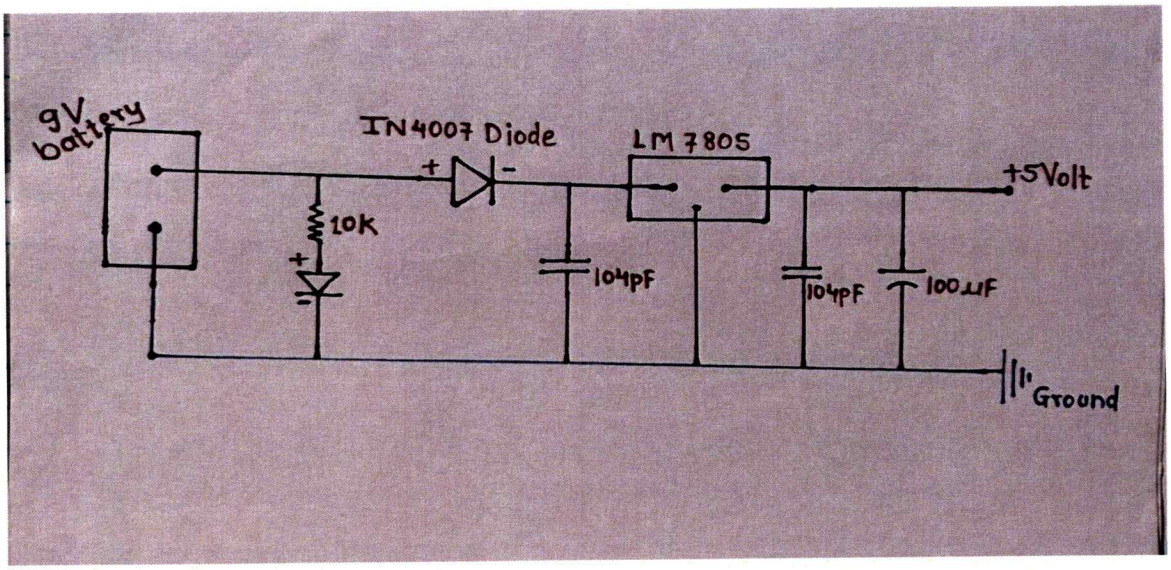



**Figure 7.1.1 Voltage regulator Circuit**

The same circuit is build on the dotted PCB for our project .

The image of the Voltage regulator circuit on dotted PCB is shown in the figure below.

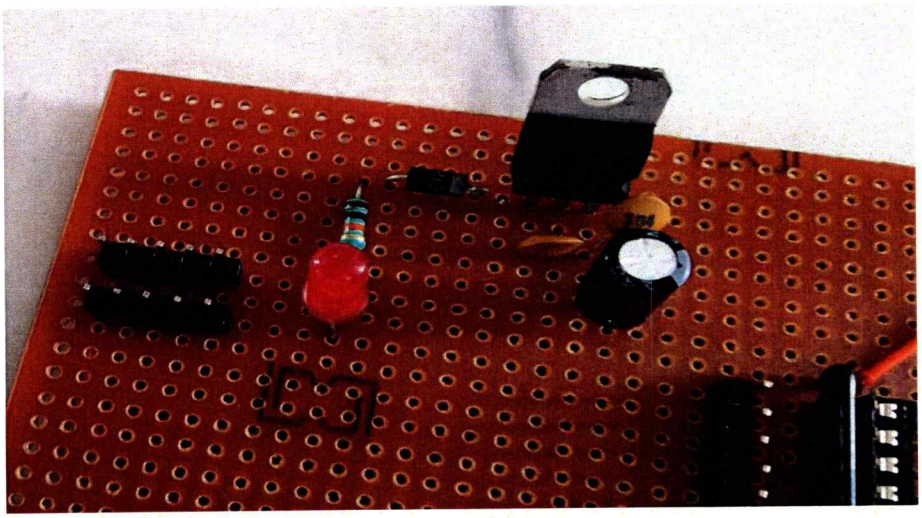


**Figure 7.1.2 Voltage regulator circuit on PCB**

With the help of this circuit we can give 5 volt of power supply to 8051 Microcontroller and other components present in the system.

## 7.2 Reset Circuit

Pin 9 of 8051 Microcontroller is for Reset.

Reset circuit consist of -

- 10uf Electrolytic capacitor
- 8.2 k resistor

The connection of the components are shows in the below circuit diagram.

Circuit Diagram :-

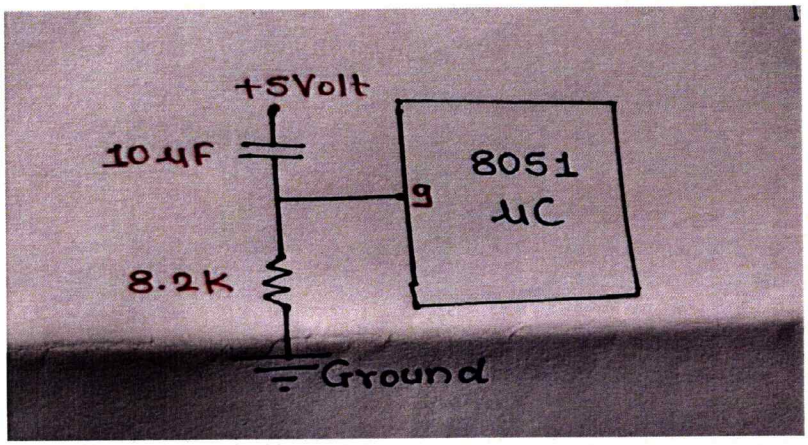



**Figure 7.2 Reset circuit**

## 7.3 Oscillator Circuit

Pin 18 and Pin 19 (XTAL2 and XTAL1) are for oscillator circuit in 8051 microcontroller .

Oscillator Circuit consist of -

- Crystal Oscillator (11.0592 MHz)
- 33 pf Ceramic Capacitor (2 pieces)

Circuit Diagram :-

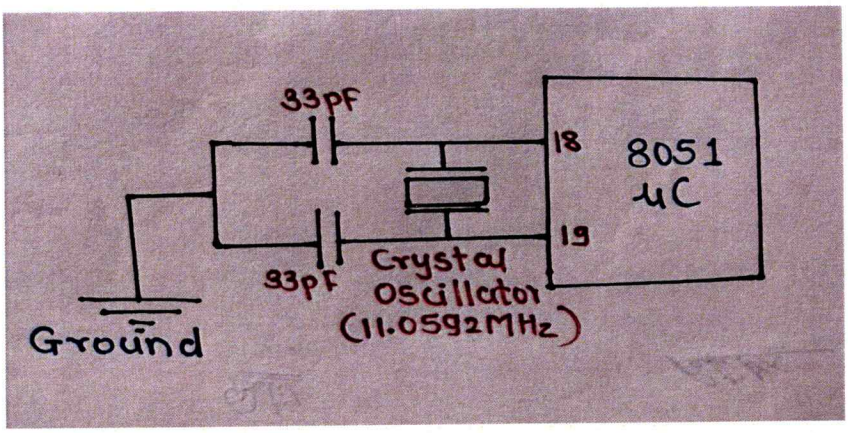



**Figure 7.3 Oscillator circuit**

The connection of reset circuit and oscillator circuit on the dotted PCB is shown in the below figure.

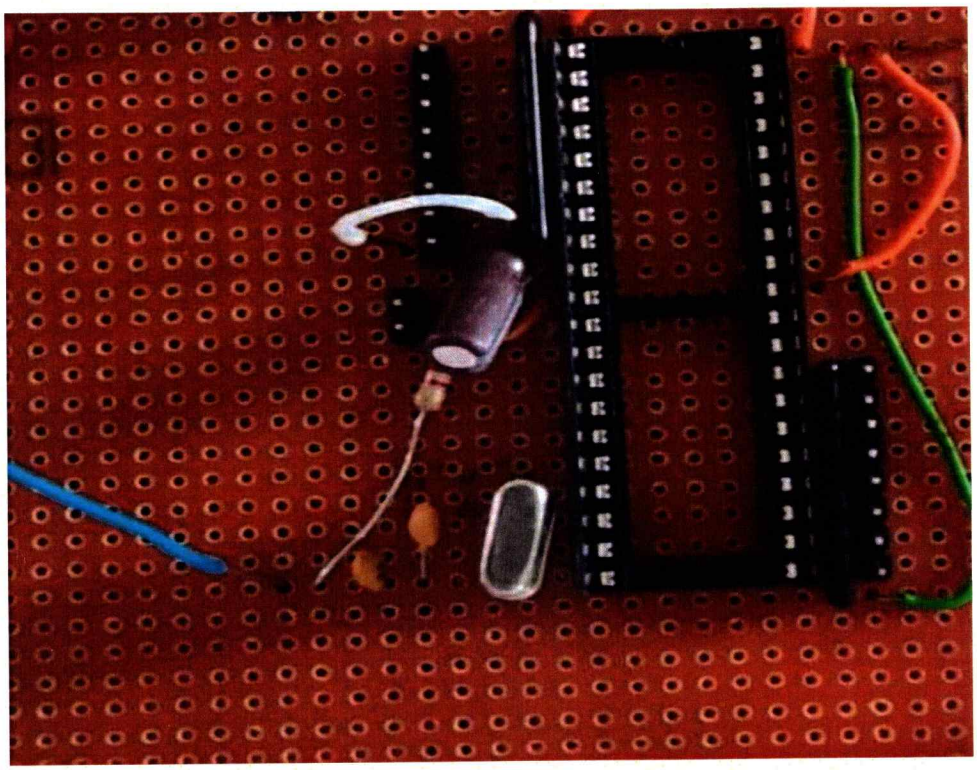


**Figure 7.4 Connection of Reset circuit and oscillator circuit on PCB**

CHAPTER 8

# INTERFACING WITH 8051 MICROCONTROLLER

## 8.1 Interfacing LCD with 8051 Microcontroller

Display units are the most Important output devices in embedded projects and electronics products. 16*2 LCD is one of the most used display unit. 16x2 LCD means that there are two rows in which 16 characters can be displayed per line.

**16*2 LCD display diagram**

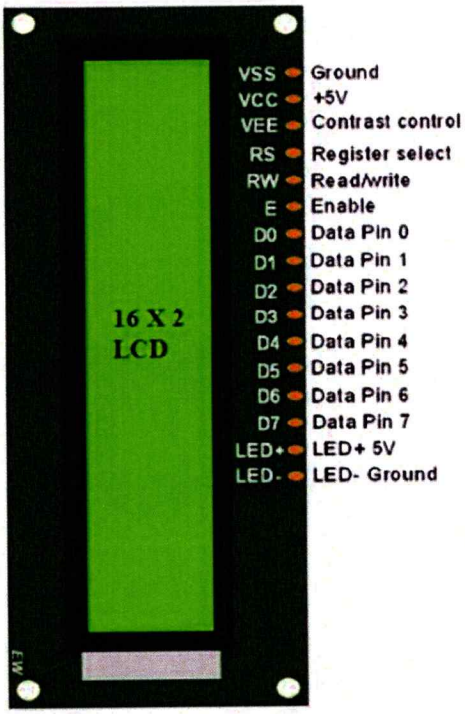



**Figure 8.1.1 16*2 LCD display**

There are total 16 pins in LCD module. we Can divided it in five categories.. Power Pins, contrast pin, Control pins, Data pins and Backlight pins.

Circuit Diagram for LCD interfacing with 8051 microcontroller is shows in the below.

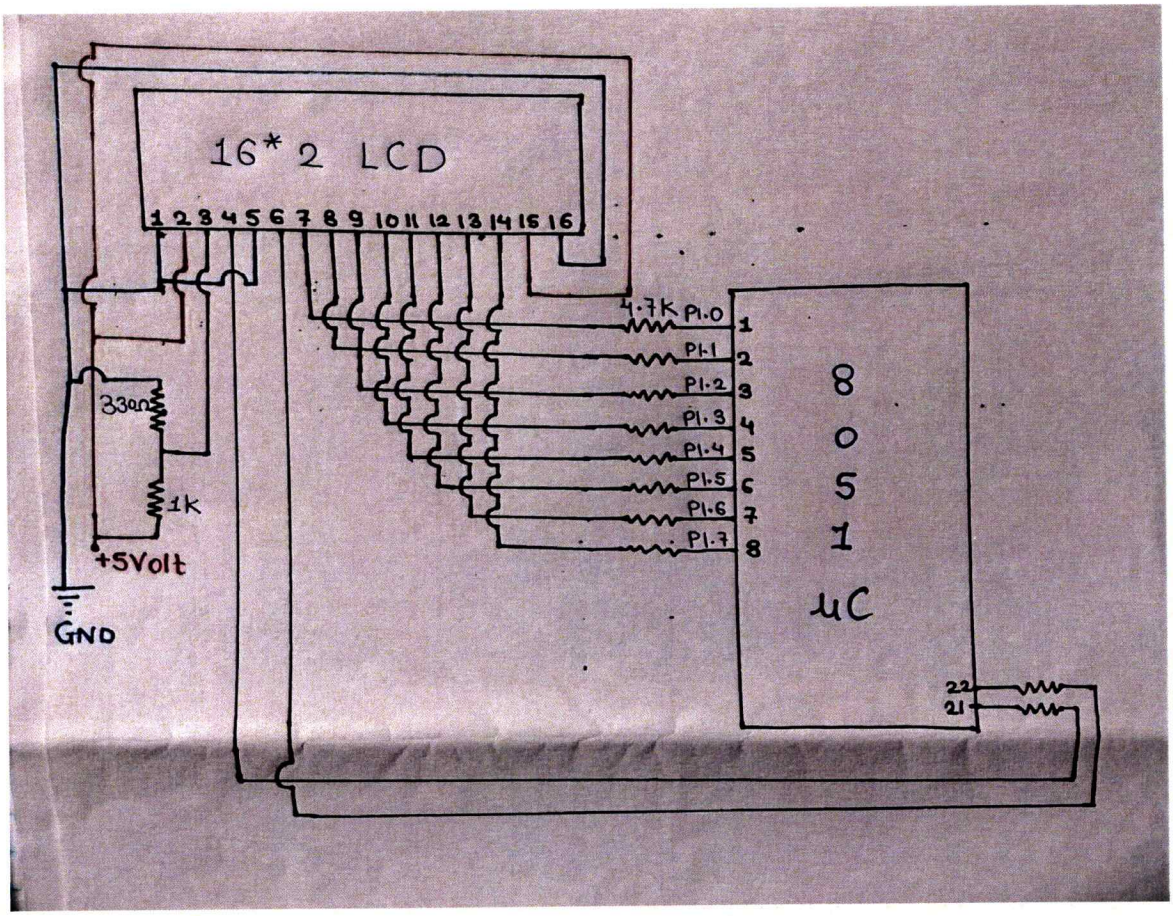



**Figure 8.1.2 Interfacing LCD with 8051 Microcontroller**

**Description**

- I have connected the data pins CDO-D7) of LCD to the Port 1 (P1.0-P1.7) of microcontroller.
- PIN 1 (VSS) and PIN 16 (Backlight ground) are Connected to ground and PIN 2 (VDD) and PIN 15 (Backlight Supply of LCD are connected to voltage (5 volt).
- PIN 5 is Connected to ground.
- PIN 4 is connected to pin 22 of microcontroller.
- PIN 6 is connected to pin 21of microcontroller.
- Pin 3(V0) is connected to voltage (Vcc) through a variable resistors 330 ohm and 1k to adjust the contrast of LCD. Middle leg of the variable resistor is connected to Pin 3 of LCD and other two legs are connected to voltage supply and ground.

## 8.2 Interfacing Alarm Buzzer and LED with 8051 Microcontroller

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type.

Alarm Buzzer and LED are used to indicate the CNG gas leakage in vehicles.

For interfacing we required. –

- Alarm Buzzer
- LED
- 1K ohm resistor
- BC547 Transistor

Circuit diagrams :-

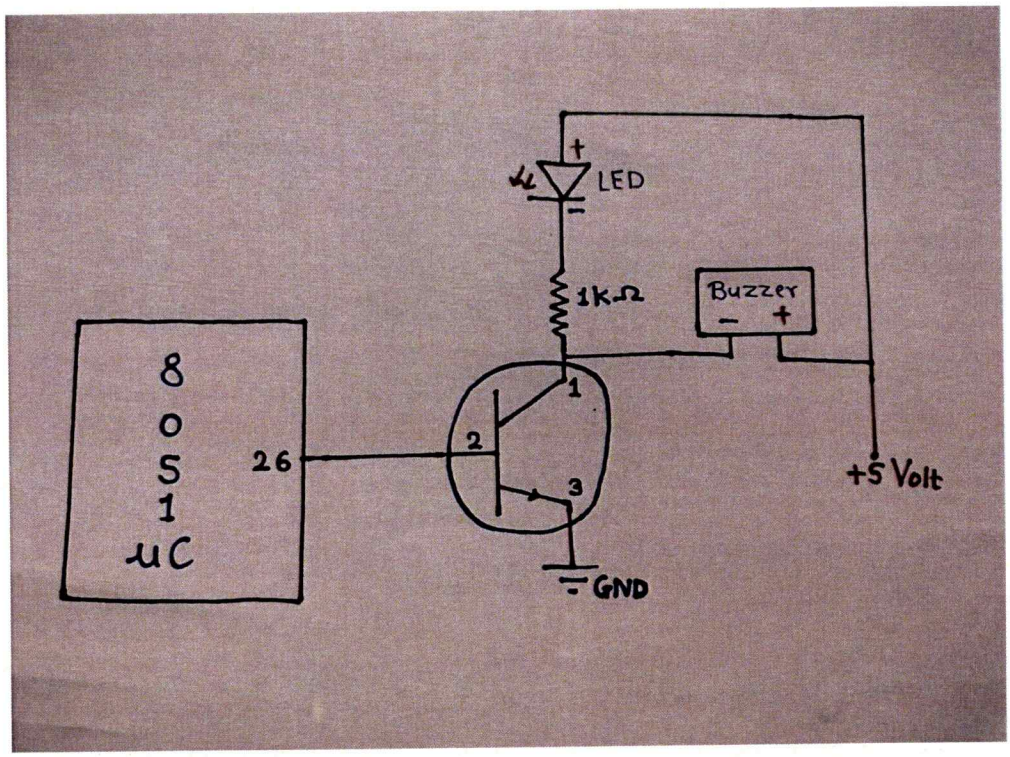



**Figure 8.2.1 Interfacing Alarm buzzer and LED with 8051 Microcontroller**

**Description**

- BC547 Transistor is usually used for current amplifier, quick Switching and pulse-width modulation CPWM).
- Pin 2 which is Base of transistor is connected to pin 26 of 8051 Microcontroller.
- Pin 3 of transistor is connected to ground.
- Pin 1 of transistor is connected to 1k **Ω resistor and** negative(-ve) pin of Buzzer.
- Then other terminal of resistor is connected to negative (-ve) terminal of LED.
- The positive terminal of LED is connected to positive (+ve) terminal of Buzzer which is connected to power Supply (+5 Volt).

Interfacing of alarm buzzer and LED with 8051 Microcontroller on dotted PCB is shown in the below figure.

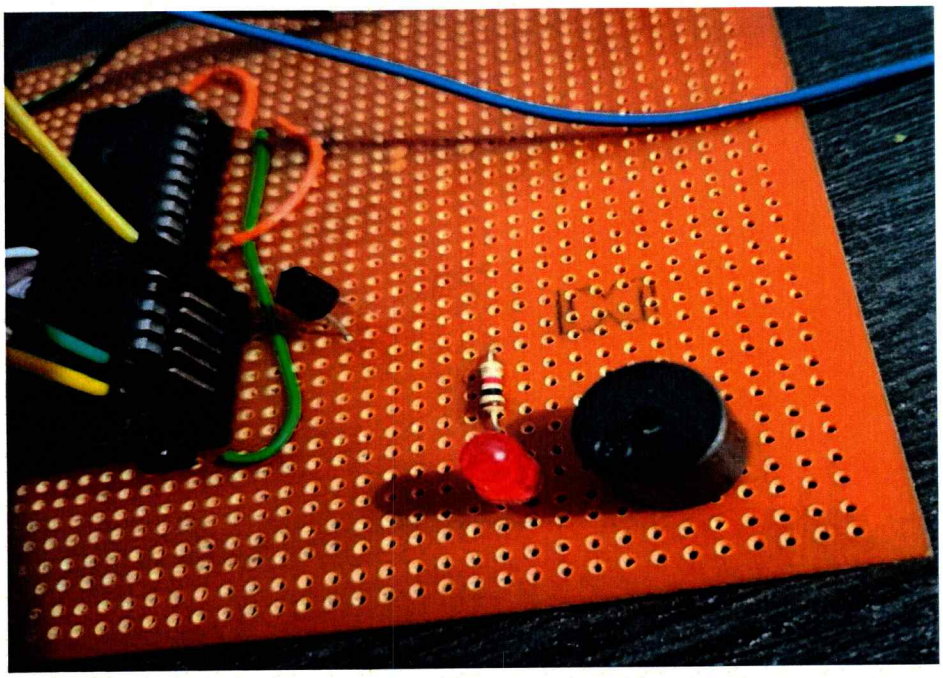


**Figure 8.2.2 Interfacing of buzzer and LED with 8051 Microcontroller on dotted PCB**

## 8.3 Interfacing HC-05 Bluetooth Module with 8051 Microcontroller

HC-05 is a Bluetooth module device used for wireless Communication.

Circuit Diagram :-

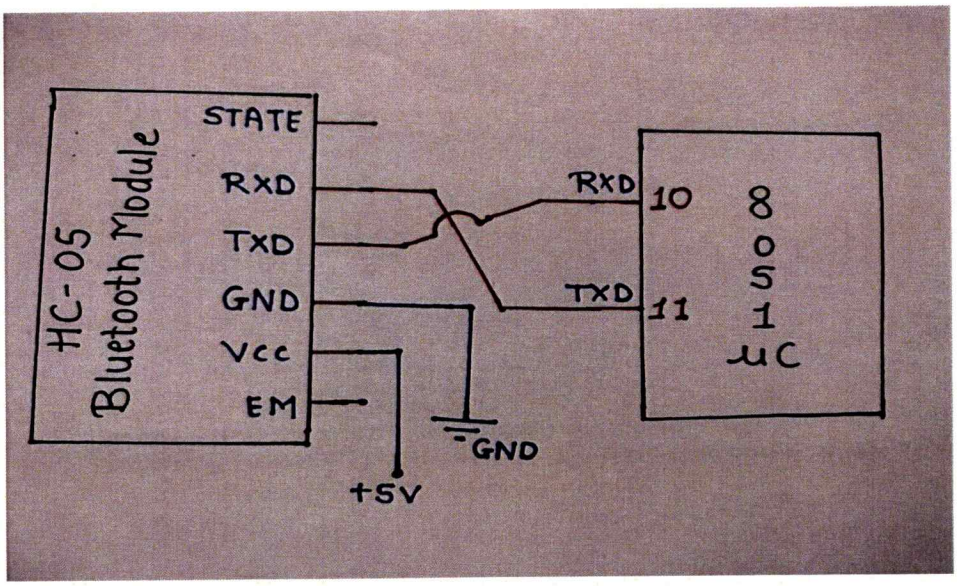



**Figure 8.3.1 Interfacing HC-05 Bluetooth Module with 8051 Microcontroller**

**Description**

- Data from HC-05 Bluetooth module is received / transmitted serially by 8051.
- RXD pin of Bluetooth module is connected with TXD pin (Pin 10) of 8051 Microcontroller.
- TXD pin of Bluetooth module is connected RXD pin ( Pin 11) of 8051 UC.
- GND pin of Bluetooth module is connected to ground .
- VCC pin of Bluetooth module is connected to power supply (+5 Volt).
- For pair this Bluetooth module with smart phone I used Serial Bluetooth terminal app.

# SONOPANT DANDEKAR ARTS, V.S. APTE COMMERCE AND M.H. MEHTA SCIENCE COLLEGE, PALGHAR

**Class :** FYBMS **Academic Year :** 2022-2023

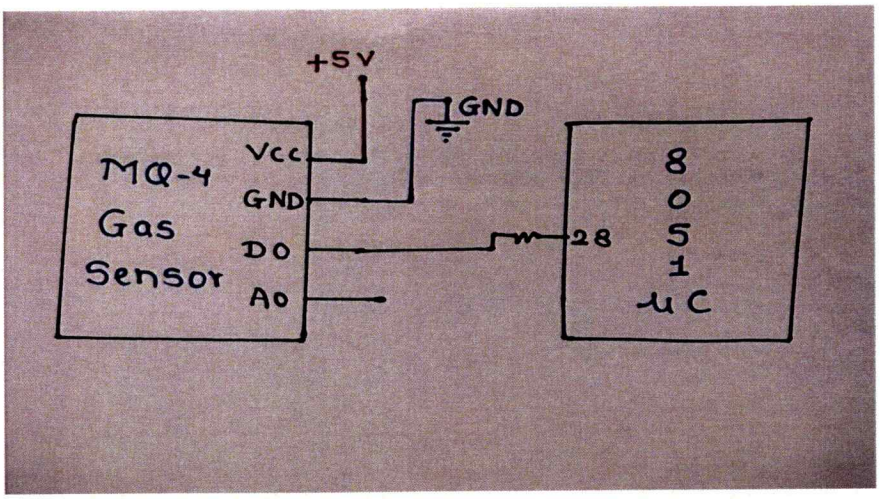
**Subject :** Foundation Course - II **Sem. :** II

| Sr. No. | Roll No. | Name of the Student | Title of the Project | Signature |
|---|---|---|---|---|
| 1 | 96001 | MANDAL SANGEETA ANUP | Make a presentation on Urbanization and problems of housing in urban areas. | Sangeeta |
| 2 | 96002 | CHAUDHARY RESHAM KRISHNA KUMAR | Perform a street play on how the changing values have negative impact on our lives | Chaudhary |
| 3 | 96003 | VEMULA ASHA VENKATESH | Undertake a programme to educate the youth regarding disadvantages of changing lifestyles in our society. | Asha |
| 4 | 96004 | GUPTA GANESH SURESH | Review the causes of farmers' suicides and suggest remedial Conduct a survey on impact of mass media on youth. | Shaunu |
| 5 | 96005 | SHARMA RITIK RAJESH | Engage in debate regard Genetically Modified Crops. | Ritik |
| 6 | 96006 | NAIK VEDANG MARUTI | Conduct a study on Genetically Modified Crops | Naik |
| 7 | 96007 | RATHOD VIKRAM GOPALSINGH | Create a public awareness campaign on criminal activities by youth and make a presentation of the same. | V. Rathod |
| 8 | 96008 | KINI TANVI KESARINATH | Make a case study presentation on farmer suicide and agrarian crisis in India. | Tanvi |
| 9 | 96009 | RAUT UDHAV PANDURANG | Undertake a case study on development of dams and human rights violation. | Raut |
| 10 | 96010 | SALIAN SHRAVYA GANESH | Visit to NGOs involved in protection of human rights and make note of responses regarding violation of human rights due to nuclear power projects. | Shravya |
| 11 | 96011 | MOULE DARSHANA KRUSHNA | Engage in group discussion on causes of crimes committed by youth. | Moule |
| 12 | 96012 | VANMALI TANVI MANOJ | Analyse the causes of suicide among the youths with reference to particular cases | TANVI |

## 8.4 Interfacing MQ-4 Gas Sensor with 8051 Microcontroller

The MQ-4 Gas Sensor works by sensing the Methane /CNG Concentration in the air.

**Circuit Diagram :-**




**8.4 Interfacing MQ-4 Gas Sensor with 8051 Microcontroller**

**Description**

- Connect the GND pin of MQ-4 Gas Sensor to the Ground.
- Connect the VCC pin of gas sensor to power supply (+5 Volt).
- Connect the digital pins (Do) of Gas Sensor to pin 28 of 8051 Microcontroller.

**Table**

| 8051 Microcontroller | MQ-4 Gas Sensor |
|---|---|
| +5 Volt | VCC |
| Ground | GND |
| Digital Pin 28 | D0 |

**Table 8.4 connection of MQ-4 Gas Sensor with 8051 Microcontroller**

## 9.1 Software Components

### 9.1.1 Keil Software

Use Keil to write programs for 8051 Microcontroller.

i. Start the Keil software. Go to the **Project > New Project** then choose a location to store your program, and give a name and **Save**.

ii. Now in the next window select the device from different manufacturers. We are selecting **Microchip**, and then by expanding we are selecting **P89V51RD2** device and click **ok**.

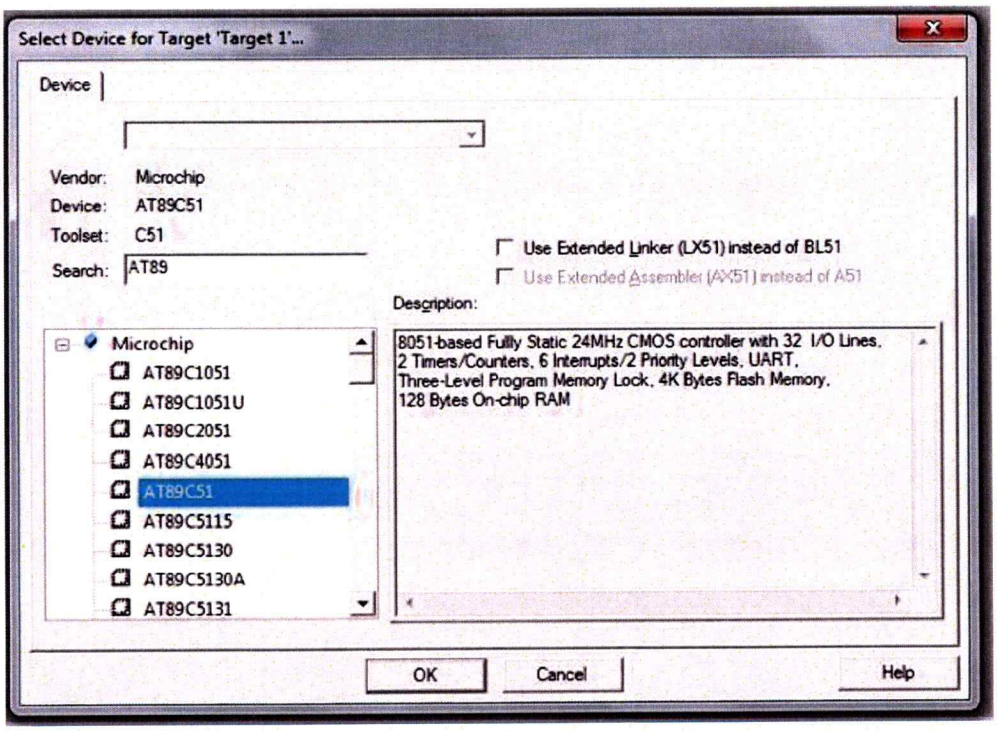



**Figure 9.1.1 For selecting device**

iii. Now go to the **New** in the menu and select **New.** It will open a new editor to write code.

iv.

v. Go to the save option and save the program file with .c extention.

vi. Write the code for 8051 Microcontroller.

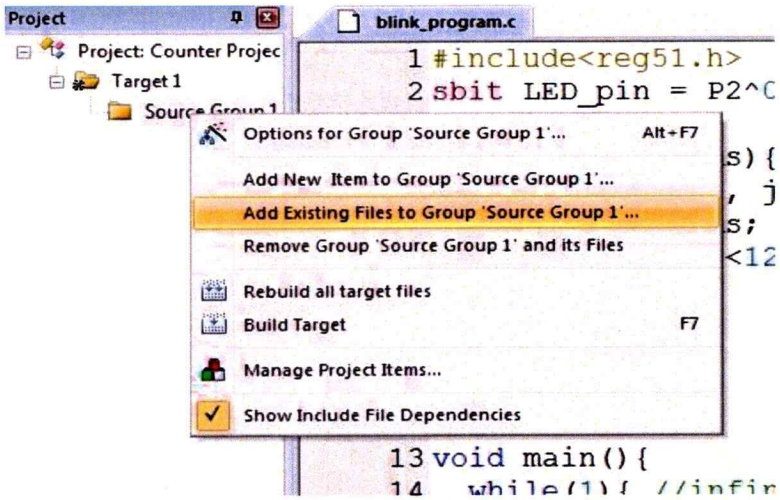



**Figure 9.1.2 For selecting File**

vii. Now from the left panel, select **Source Group 1**, and **Add Existing Files to Group 'Source Group'**. Then select the program (c file) then **add and close**.

viii. Now go to the **Project > Build Target** to build the project. If there is some error the building will be failed, after correcting the errors it can be build.

ix. **Now click on the Target1 from the left panel and select Options for Target 'Target'. Then** set the XTAL (MHz) value to **11.0592**. Check mark on the Use On Chip ROM. Then go to the output tab. In this tab check Create Hex File, and click OK. Then build it again.

x. Then write the program code in the software.

### 9.1.2 Flash Magic Software

Flash magic software is use to burn the program which is written in the Keil uvision 4 software .

i. In Flash magic software select IC for this project, select **IC P89V51RD2 .**

ii. Go to the Search ⟶ Device manager ⟶ Port ⟶ Name of the port .

iii. Name the Port which is shown in the device manager. For example, Com 4 , Com 3,etc.

iv. Then click on the browser to search the exact project code location .

v. After that click on the start button to burn the program in the IC P89V51RD2.

### 9.1.3 Proteus Software

Proteus is software used to draw and design and integrate electronic circuits. After designing circuits by taking various parts like Microcontroller, gas sensor, LED, LCD it also provides to simulate and test designed circuit. After testing in real-time we can go to make this circuit practically in our physical world.

## 9.2 Circuit Diagram

Circuit diagram of the project is shown in below figure.

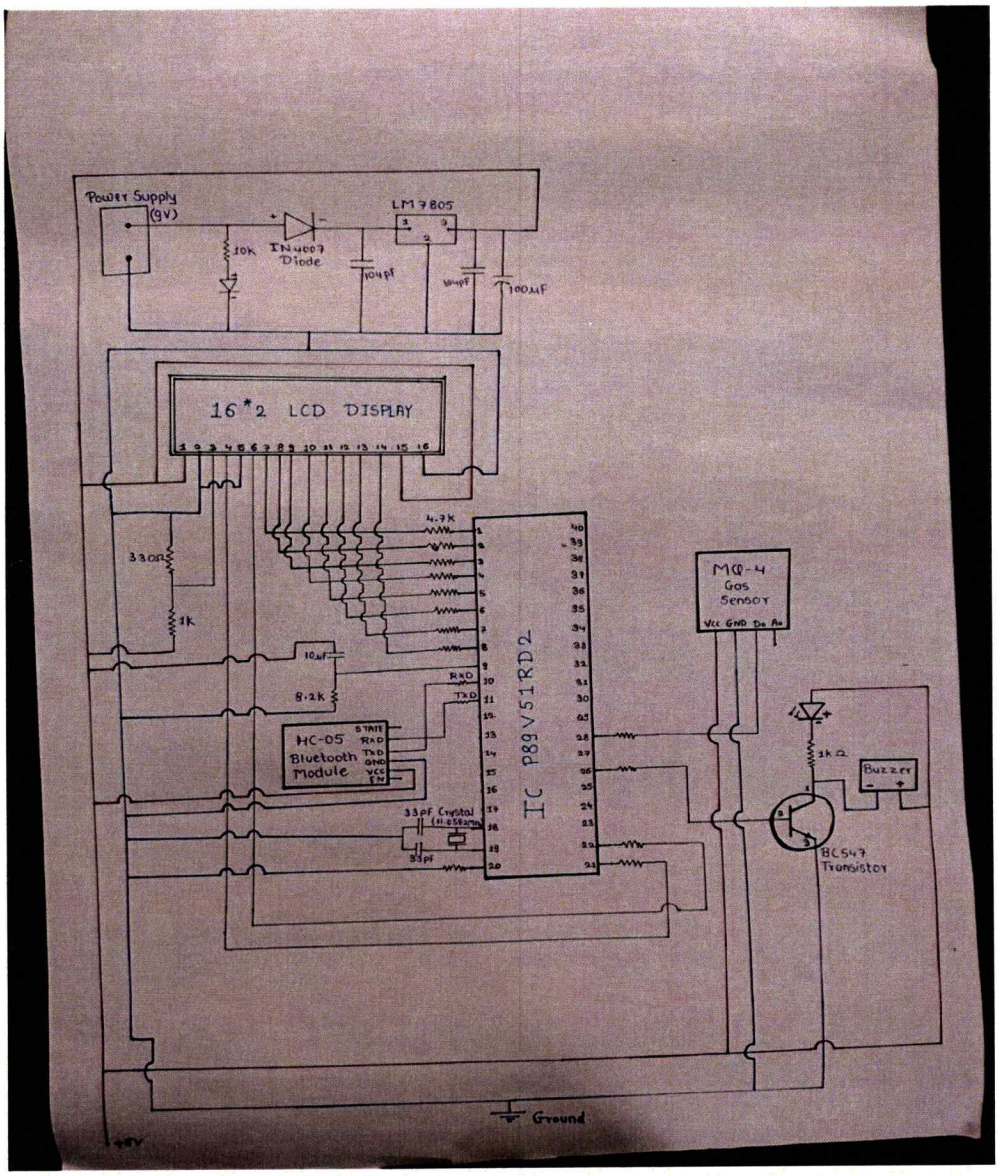



**Figure 9.2.1 Circuit diagram of the project**

Before making the actual connection first I make the diagram on the Proteus software, run the system on the proteus software and then make the system on the PCB.

Below figure shows the circuit diagram on the Proteus Software.

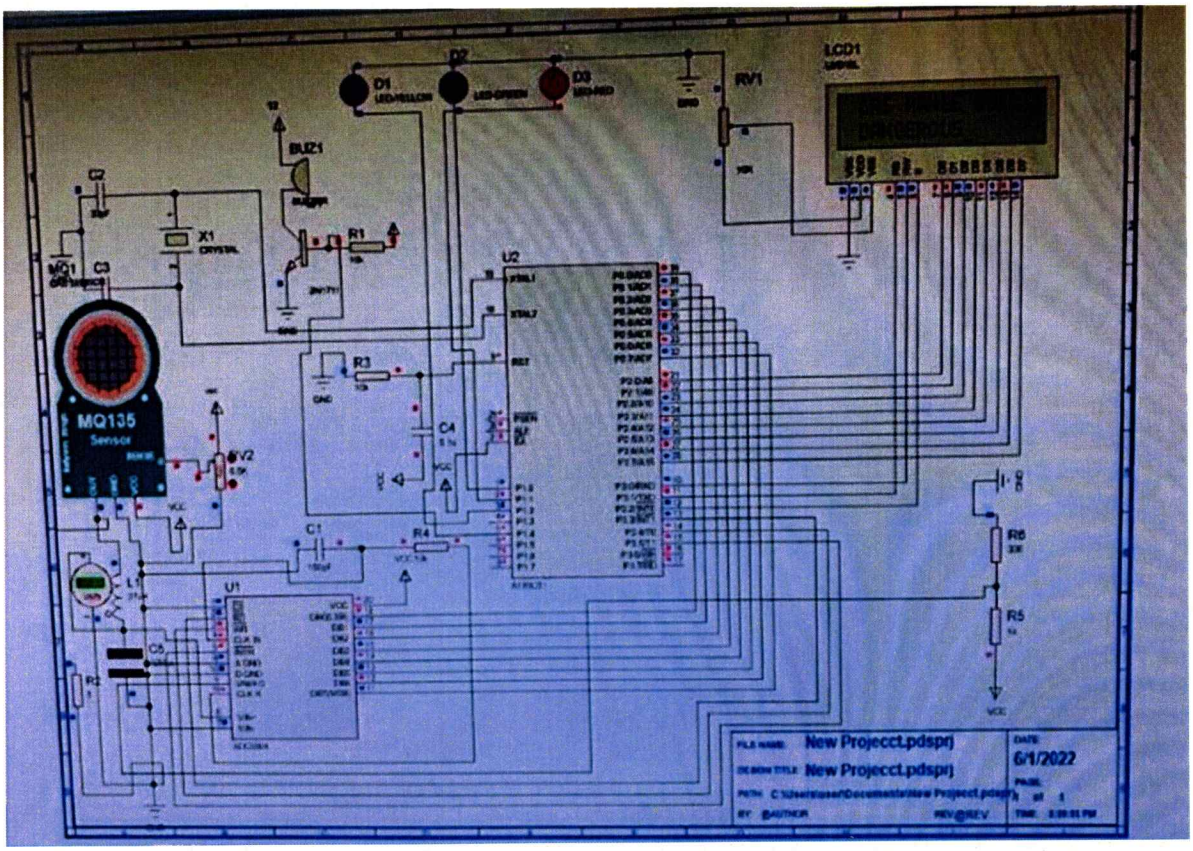



**Figure 9.2.2 Circuit diagram of project on Proteus Software**

## 9.3 Project Code in assembly C++ language

```
#include <reg51.h>

#define output P1//lcd

void delay(unsigned int msec);

void lcd_cmd(unsigned char a);

 void lcd_data(unsigned char b);

void lcd_init(void);

void lcd_str(unsigned char *str);


void send_sms(void);

 void Uart_Init();

void send_str (unsigned char *str);

 void send_char (unsigned char chr);


sbit buzzer=P2^5;//buzzer

 sbit rs=P2^0;//lcd

 sbit en=P2^1;//lcd


 sbit d0=P2^7;//adc d0 digital out

 //sfr ldata=0x90;//port1
```

```
//sbit L1=P2^2;


void main()
{


Uart_Init();
output=0x00;
d0=1;
buzzer=0;


//lcd srt
lcd_init();
lcd_str ("  WELCOME TO  ");
lcd_cmd(0xc0);
lcd_str("  MY PROJECT  ");


delay(1);
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd_str("  CNG DETECTION  ");
lcd_cmd(0xc0);
```

```
lcd_str(" IN VEHICLE ");
delay(1);

while(1)
{
if(d0==0)
{
lcd_cmd (0x01);
lcd_cmd(0x80);
lcd_str(" CNG gas detected ");
lcd_cmd(0xc0);
send_sms();// Bluetooth
lcd_str("  alert  ");
delay(1);

delay(3600);
buzzer=0;
delay(100);//
}
else
{
```

```
lcd_cmd(0x01);
lcd_cmd(0x80);
 lcd_str("  no gas leakage  ");
 lcd_cmd(0xc0);
}
}
}
void delay(unsigned int msec)
 {
 int i,j;
 for(i=0;i<msc;i++)
for(j=0;j<1275;j++) ;

 }

void lcd_init()
 {
lcd_cmd(0x38);
lcd_cmd(0x0c);
 lcd_cmd(0x01);
lcd_cmd(0x80);
```

```
}

void lcd_cmd(unsigned char a)
{
rs=0;//cmd
output=a;
en=1;
delay(5);
en=0;
delay(5);
}
 void lcd_str(unsigned char *str)
{
 while(*str)
 {
lcd_data(*str++);
 }

 }
 void lcd_data(unsigned char b)
 {
```

```
rs=1;//data
output=b;
en=1;
delay(5);
en=0;
delay(5);
}

//----------------------------------------


 void Uart_Init()
 {
 SCON = 0x50; // SCON: mode 1, 8-bit UART, enable receive
 TMOD |= 0x20; // TMOD: timer 1, mode 2, 8-bit
 TH1 = 0xFD; // TH1: for 9600 baud
  TR1 = 1; //TR1: timer 1 run
  }
```

```
void send_str(unsigned char *str)
{
 while(*str)
 {
 send_char(*str++);
 }
 send_char(0x0D);
 }
 void send_char (unsigned char chr)
 {
 SBUF = chr;
while (TI==0); //Wait until the character is completely sent
TI=0; //Reset the Transmit Interrupt flag
 }
 void send_sms(void)
 {
 buzzer=1;
 send_str("  CNG gas leakage detected  ");
 delay(100);
 }
```

## 9.4 Experimental Setup

The whole system of the project is build on breadboard. All components that is required for the project are connected on it. For this project I used **IC P89V51RD2** Microcontroller . First I check the project setup on the breadboard .

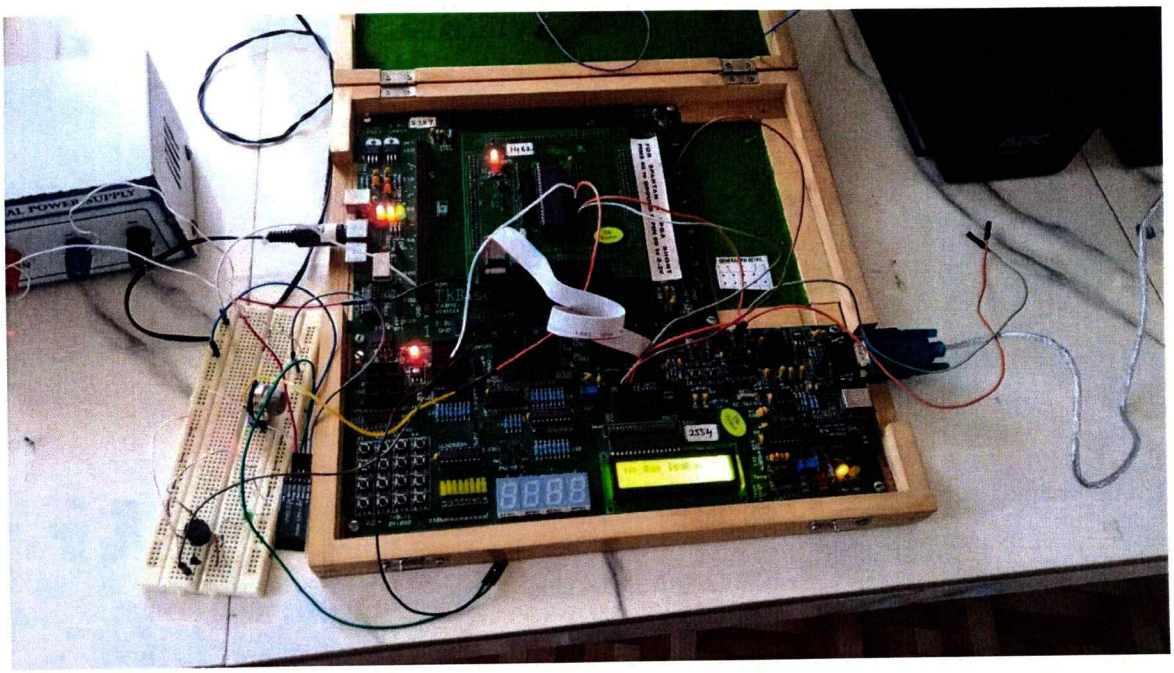


**Figure 9.4.1 Experimental setup of the project on the breadboard**

After checking the project system on the breadboard and checking the output of the system I build this entire system on the dotted PCB for the project.

As this system is fixed in the CNG functioning vehicles so for this I used 9 Volt battery for power supply.

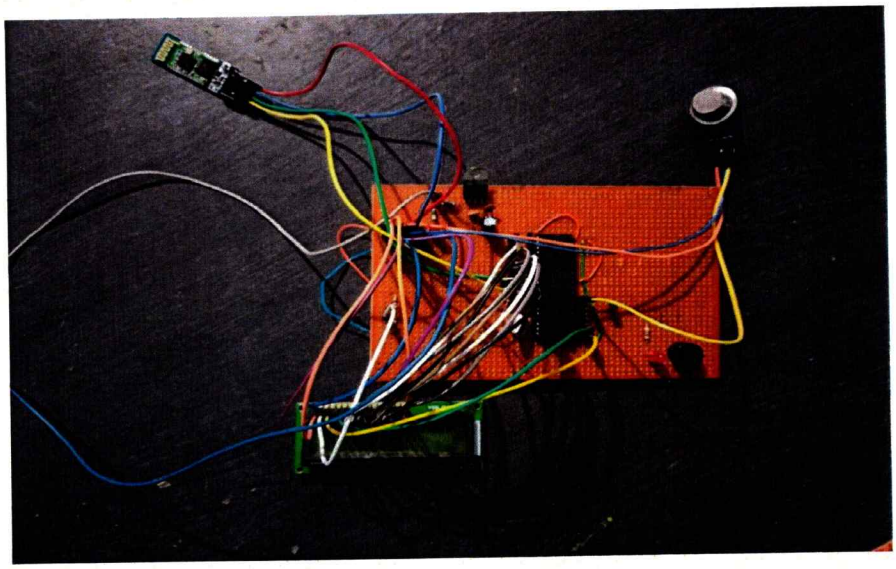


**Figure 9.4.2 Experimental setup of the project on the dotted PCB**

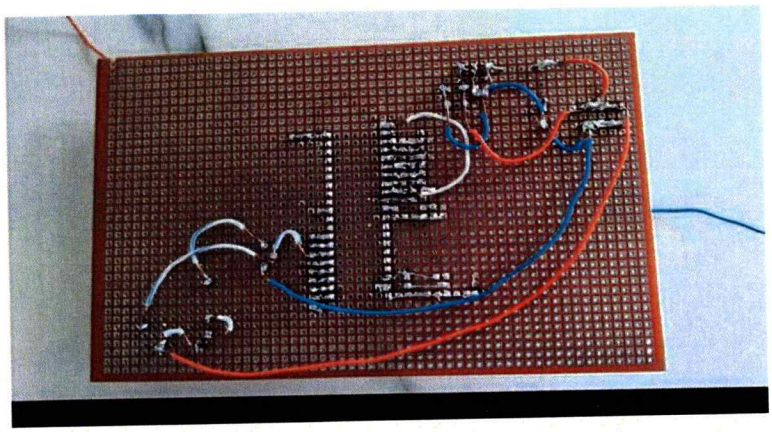


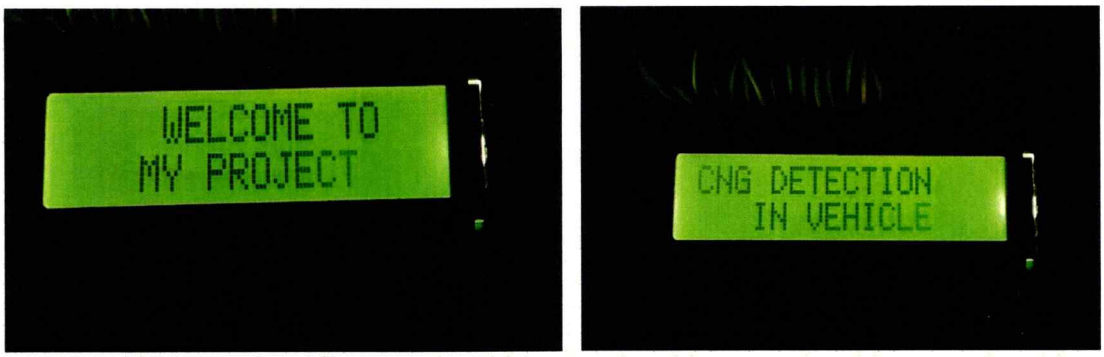
**Figure 9.4.3 Back side of PCB**

The back side of the dotted PCB is shown in the Fig.9.3.3. I used blue wires for ground connection and orange wires for +5 volt connection.

## 9.5 Working Process

i. The power supply is gives by 9 Volt of the battery.

ii. At the start of the system Welcome message is display on 16*2 LCD display .




a) b)

**Figure 9.5.1 Welcome message is display on LCD display**

iii. When no gas is leakage at that time No Gas Leakage is display on the screen.


**Figure 9.5.2 no gas leakage message on LCD display**

iv. I used Lightter to release gas near MQ-4 gas sensor as lighter contain Methane gas which is also present in the CNG gas .

v. When CNG gas leakage is detected by the MQ-4 gas sensor at that time -

- The alert message is display on the LCD display


**Figure 9.5.3 Alert message display on LCD display**

- LED start glow
- Buzzer start
- Alert message is send on the phone.

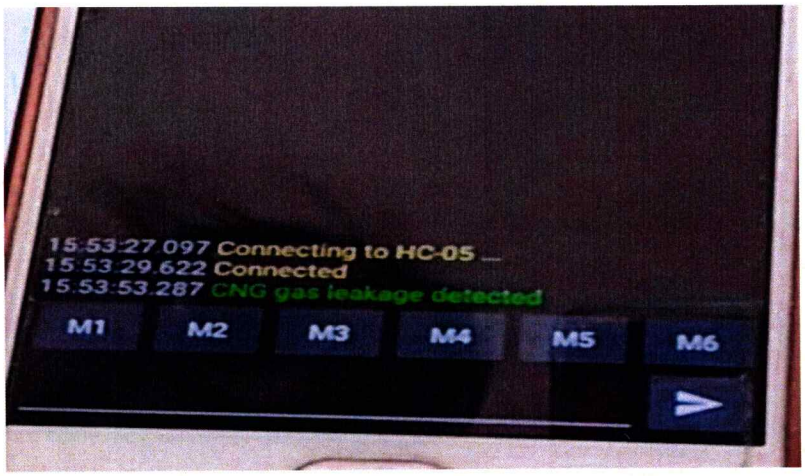



**Figure 9.5.4 Alert message on Mobile**

vi. Buzzer beep for the 1 minute after that it stop.

vii. So that driver and passenger alert and take proper precaution to avoid major accident.

# CHAPTER 10 RESULT AND DISCUSSION

## 10.1 Results

1.This Automatic alarm buzzer during CNG gas leakage in vehicles system detect the gas leakage happens in vehicles and after detected the gas leakage buzzer the alarm .Also display message on Liquid Crystal Display(LCD) at head unit using 8051 microcontroller and gas detector sensor (MQ4) .

2.With the help of Bluetooth module message send on the smart phone.

3. The main purpose of the alarm is to alert the driver and passengers of the potential danger and prompt them to take appropriate action.

## 10.2 Discussion

The automatic alarm buzzer serves as an important safety feature in CNG gas functioning vehicles. Its effectiveness relies on the timely detection of gas leakage and the ability to produce a loud and distinct sound that can be easily noticed by individuals inside the vehicle and alert message is display on the dashboard.

Also the alert message is send on the phone which is connected through Bluetooth So in case the **vehicle is park and the person who's phone is connected is nearby the vehicle then with the** help of the alert message he/she can take required action.

The combination of these safety features provides a comprehensive approach to managing gas leaks and ensuring the safety of the vehicle occupants.

It is important to regularly maintain and test the alarm system and other components to ensure its reliability. Periodic inspections are essential to confirm that it is in proper working condition and will activate when needed.

# CHAPTER 11 FUTURE SCOPE

The future scope of the project focused on enhancing safety measures and improving the overall effectiveness of the alarm system. Here are some potential areas of future development:

1. Advanced Detection Systems: Research and development efforts can be directed towards improving gas leak detection systems. This includes developing more sensitive and accurate sensors that can detect even minor gas leaks at an early stage.

2. Smart Notifications and Communication: These notifications can provide more detailed information about the gas leak, suggested actions, and nearby service stations or emergency contacts for assistance.

3. Enhanced User Interface: The alarm system can benefit from a more intuitive and user-friendly interface. This can include visual indicators, clear instructions, and voice prompts to guide occupants on appropriate actions to take in case of a gas leak. User-friendly interfaces help to ensure that individuals understand the alarm signals and respond effectively in emergency situations.

4. Research on Alternative Fuel Safety: As the automotive industry continues to explore alternative fuels, such as hydrogen or electric vehicles, future projects can focus on developing safety mechanisms specific to these fuel types.

5. Regulatory and Standardization Efforts: Collaboration with regulatory bodies and industry organizations can help establish standards and guidelines for alarm systems in CNG vehicles. Future projects can contribute to the development of regulations and best practices to ensure consistent safety standards across vehicles and manufacturers.

In summary, the future scope of the project includes advancements in gas leak detection, integration with vehicle telematics, improved user interfaces, integration with active safety systems, research on alternative fuel safety, and collaboration with regulatory bodies. These efforts aim to enhance safety measures, provide faster and more effective responses to gas leaks, and ensure the overall safety of CNG vehicles and their occupants.

# CHAPTER 11 CONCLUSION

CNG leakage can recognized through this system.

1. This system can prevent or minimize the cause of accidents happens due to CNG leakage in vehicles.
2. Gas leakage is the major critical threat within the automotive industries, also as in residential areas. lately Safety plays important roles towards security over the gas leakage.
3. By notifying individuals in the vehicle, the alarm allows them to take immediate action, such as evacuating the vehicle and seeking assistance. This early warning can help prevent accidents, fires, or explosions resulting from CNG gas leaks.
4. It is important to note that in addition to the alarm buzzer, CNG vehicles are typically equipped with other safety mechanisms, such as gas leak sensors and shut-off valves, to mitigate the risks associated with gas leaks. The combination of these safety features is designed to ensure the well-being of the vehicle occupants and minimize the potential for harm in case of a CNG gas leak.
5. This is a low cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and easy system device can detect the leakage of Compressed Natural gas (CNG).
6. In conclusion, the automatic alarm buzzer in CNG gas functioning vehicles plays a vital role in alerting individuals to the presence of a gas leak, enabling them to take immediate action and potentially prevent accidents or hazards associated with CNG gas leaks.

# REFERENCE

[1] T. Murugan, A. Periasamy and S. Muruganand, "Embedded Based Industrial temperature monitoring system using GSM", International Journal
of computer applications.

[2] V. Ramya and B. Palaniappan, "Embedded system for Hazardous gas detection and Alerting," in Proc. of International Journal of Distributed
and parallel system (IJDPS), vol. 3, no. 3, May 2012.

[3] L. Solis, Y. Li and L. B. Kishs, "Fluctuation-Enhanced Multiple-gas sensing by Commercial Taguchi Sensor,"IEEE Sensor Journal, vol. 5, no.
6, Dec 2005.

[4] H. G. Rodney Tan, C. H. Lee and V. H. Mok, "Automatic Power Meter Reading System Meter Reading Using GSM Network," in Proc. of
the 8 Th International Conference.

[5] H. Huang, H. Bainand S. Zhu, "A Greenhouse Remote Monitoring System Based on GSM,"
in Proc. of IEEE International Conference on
information management.

[6] A Jain, D. Kumar and J. Kedia, "Design and development of GSM based energy Meter, "International Journal of Computer Application, vol.
47, no. 12, June 2012.

[7] S. Shinde, S. B. Patil and A. J. Patil, "Development of movable gas tanker leakage detection using wireless sensor network based on embedded
system," International Journal of Engineering Research and Application(IJTERA), vol. 2, pp. 1180-1183, Nov.-Dec. 2012.

# P89V51RD2

8-bit 80C51 5 V low power 64 kB Flash microcontroller with 1 kB RAM

Rev. 01 — 01 March 2004 Product data

## 1. General description

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM.

A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible.

The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

## 2. Features

- 80C51 Central Processing Unit
- 5 V Operating voltage from 0 to 40 MHz
- 64 kB of on-chip Flash program memory with ISP (In-System Programming) and IAP (In-Application Programming)
- Supports 12-clock (default) or 6-clock mode selection via software or ISP
- SPI (Serial Peripheral Interface) and enhanced UART
- PCA (Programmable Counter Array) with PWM and Capture/Compare functions
- Four 8-bit I/O ports with three high-current Port 1 pins (16 mA each)
- Three 16-bit timers/counters
- Programmable Watchdog timer (WDT)
- Eight interrupt sources with four priority levels
- Second DPTR register
- Low EMI mode (ALE inhibit)
- TTL- and CMOS-compatible logic levels

## 4. Block diagram

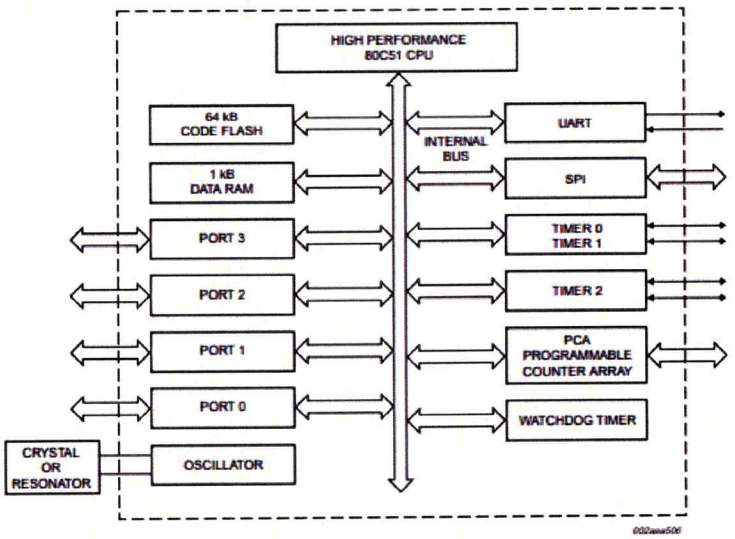



Fig 1. P89V51RD2 block diagram.

## Pinning information

### 5.1 Pinning

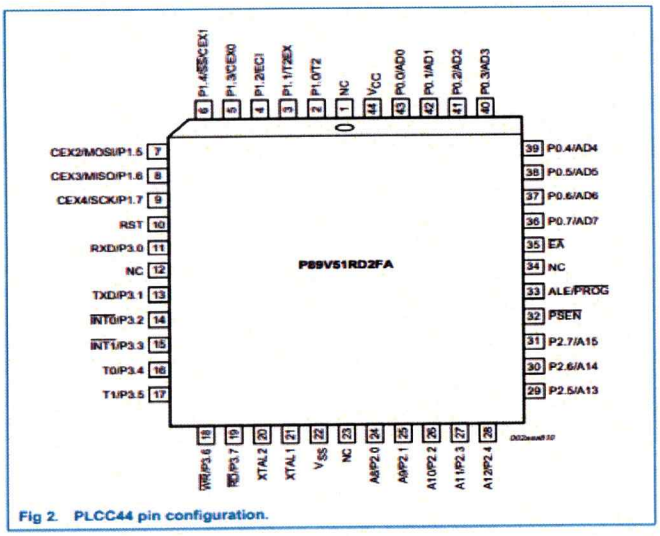



Fig 2. PLCC44 pin configuration.

## 5.2 Pin description

Table 3: P89V51RD2 pin description

| Symbol | Pin | | | Type | Description |
|---|---|---|---|---|---|
| | DIP40 | TQFP44 | PLCC44 | | |
| P0.0 to P0.7 | 39-32 | 37-30 | 43-36 | I/O | **Port 0:** Port 0 is an 8-bit open drain bi-directional I/O port. Port 0 pins that have '1's written to them float, and in this state can be used as high-impedance inputs. Port 0 is also the multiplexed low-order address and data bus during accesses to external code and data memory. In this application, it uses strong internal pull-ups when transitioning to '1's. Port 0 also receives the code bytes during the external host mode programming, and outputs the code bytes during the external host mode verification. External pull-ups are required during program verification or as a general purpose I/O port. |
| P1.0 to P1.7 | 1-8 | 40-44, 1-3 | 2-9 | I/O with internal pull-up | **Port 1:** Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 pins are pulled high by the internal pull-ups when '1's are written to them and can be used as inputs in this state. As inputs, Port 1 pins that are externally pulled LOW will source current ($I_{IL}$) because of the internal pull-ups. P1.5, P1.6, P1.7 have high current drive of 16 mA. Port 1 also receives the low-order address bytes during the external host mode programming and verification. |
| P1.0 | 1 | 40 | 2 | I/O | **T2:** External count input to Timer/Counter 2 or Clock-out from Timer/Counter 2 |
| P1.1 | 2 | 41 | 3 | I | **T2EX**: Timer/Counter 2 capture/reload trigger and direction control |
| P1.2 | 3 | 42 | 4 | I | **ECI**: External clock input. This signal is the external clock input for the PCA. |
| P1.3 | 4 | 43 | 5 | I/O | **CEX0**: Capture/compare external I/O for PCA Module 0. Each capture/compare module connects to a Port 1 pin for external I/O. When not used by the PCA, this pin can handle standard I/O. |
| P1.4 | 5 | 44 | 6 | I/O | **$\overline{SS}$**: Slave port select input for SPI<br>**CEX1**: Capture/compare external I/O for PCA Module 1 |
| P1.5 | 6 | 1 | 7 | I/O | **MOSI**: Master Output Slave Input for SPI<br>**CEX2**: Capture/compare external I/O for PCA Module 2 |
| P1.6 | 7 | 2 | 8 | I/O | **MISO**: Master Input Slave Output for SPI<br>**CEX3**: Capture/compare external I/O for PCA Module 3 |
| P1.7 | 8 | 3 | 9 | I/O | **SCK**: Master Output Slave Input for SPI<br>**CEX4**: Capture/compare external I/O for PCA Module 4 |

Table 3: P89V51RD2 pin description...*continued*

| Symbol | Pin | | | Type | Description |
|---|---|---|---|---|---|
| | DIP40 | TQFP44 | PLCC44 | | |
| P2.0 to P2.7 | 21-28 | 18-25 | 24-31 | I/O with internal pull-up | **Port 2**: Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. Port 2 pins are pulled HIGH by the internal pull-ups when '1's are written to them and can be used as inputs in this state. As inputs, Port 2 pins that are externally pulled LOW will source current ($I_{IL}$) because of the internal pull-ups. Port 2 sends the high-order address byte during fetches from external program memory and during accesses to external Data Memory that use 16-bit address (MOVX@DPTR). In this application, it uses strong internal pull-ups when transitioning to '1's. Port 2 also receives some control signals and a partial of high-order address bits during the external host mode programming and verification. |
| P3.0 to P3.7 | 10-17 | 5, 7-13 | 11, 13-19 | I/O with internal pull-up | **Port 3**: Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. Port 3 pins are pulled HIGH by the internal pull-ups when '1's are written to them and can be used as inputs in this state. As inputs, Port 3 pins that are externally pulled LOW will source current ($I_{IL}$) because of the internal pull-ups. Port 3 also receives some control signals and a partial of high-order address bits during the external host mode programming and verification. |
| P3.0 | 10 | 5 | 11 | I | **RXD**: serial input port |
| P3.1 | 11 | 7 | 13 | O | **TXD**: serial output port |
| P3.2 | 12 | 8 | 14 | I | **$\overline{\text{INT0}}$**: external interrupt 0 input |
| P3.3 | 13 | 9 | 15 | I | **$\overline{\text{INT1}}$**: external interrupt 1 input |
| P3.4 | 14 | 10 | 16 | I | **T0**: external count input to Timer/Counter 0 |
| P3.5 | 15 | 11 | 17 | I | **T1**: external count input to Timer/Counter 1 |
| P3.6 | 16 | 12 | 18 | O | **$\overline{\text{WR}}$**: external data memory write strobe |
| P3.7 | 17 | 13 | 19 | O | **$\overline{\text{RD}}$**: external data memory read strobe |
| $\overline{\text{PSEN}}$ | 29 | 26 | 32 | I/O | **Program Store Enable**: $\overline{\text{PSEN}}$ is the read strobe for external program memory. When the device is executing from internal program memory, $\overline{\text{PSEN}}$ is inactive (HIGH). When the device is executing code from external program memory, $\overline{\text{PSEN}}$ is activated twice each machine cycle, except that two $\overline{\text{PSEN}}$ activations are skipped during each access to external data memory. A forced HIGH-to-LOW input transition on the $\overline{\text{PSEN}}$ pin while the RST input is continually held HIGH for more than 10 machine cycles will cause the device to enter external host mode programming. |
| RST | 9 | 4 | 10 | I | **Reset**: While the oscillator is running, a HIGH logic state on this pin for two machine cycles will reset the device. If the $\overline{\text{PSEN}}$ pin is driven by a HIGH-to-LOW input transition while the RST input pin is held HIGH, the device will enter the external host mode, otherwise the device will enter the normal operation mode. |

Table 3: P89V51RD2 pin description...*continued*

| Symbol | Pin | | | Type | Description |
|---|---|---|---|---|---|
| | DIP40 | TQFP44 | PLCC44 | | |
| $\overline{EA}$ | 31 | 29 | 35 | I | **External Access Enable:** $\overline{EA}$ must be connected to $V_{SS}$ in order to enable the device to fetch code from the external program memory. $\overline{EA}$ must be strapped to $V_{DD}$ for internal program execution. However, Security lock level 4 will disable $\overline{EA}$, and program execution is only possible from internal program memory. The $\overline{EA}$ pin can tolerate a high voltage of 12 V. |
| ALE/ $\overline{PROG}$ | 30 | 27 | 33 | I/O | **Address Latch Enable:** ALE is the output signal for latching the low byte of the address during an access to external memory. This pin is also the programming pulse input ($\overline{PROG}$) for flash programming. Normally the ALE[1] is emitted at a constant rate of $\frac{1}{6}$ the crystal frequency[2] and can be used for external timing and clocking. One ALE pulse is skipped during each access to external data memory. However, if AO is set to '1', ALE is disabled. |
| NC | - | 6, 17, 28, 39 | 1, 12, 23, 34 | I/O | **No Connect** |
| XTAL1 | 19 | 15 | 21 | I | **Crystal 1:** Input to the inverting oscillator amplifier and input to the internal clock generator circuits. |
| XTAL2 | 18 | 14 | 20 | O | **Crystal 2:** Output from the inverting oscillator amplifier. |
| $V_{DD}$ | 40 | 38 | 44 | I | **Power supply** |
| $V_{SS}$ | 20 | 16 | 22 | I | **Ground** |

[1] ALE loading issue: When ALE pin experiences higher loading (>30 pF) during the reset, the microcontroller may accidentally enter into modes other than normal working mode. The solution is to add a pull-up resistor of 3 kΩ to 50 kΩ to $V_{DD}$, e.g., for ALE pin.

[2] For 6-clock mode, ALE is emitted at $\frac{1}{3}$ of crystal frequency.

# MQ-4 Gas Sensor



## TECHNICAL DATA MQ-4 GAS SENSOR

### FEATURES

* High sensitivity to $CH_4$, Natural gas.
* Small sensitivity to alcohol, smoke.
* Fast response . * Stable and long life * Simple drive circuit

### APPLICATION

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of $CH_4$,Natural gas,LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke.

### SPECIFICATIONS

A. Standard work condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Vc | Circuit voltage | 5V±0.1 | AC OR DC |
| $V_H$ | Heating voltage | 5V±0.1 | ACOR DC |
| $P_L$ | Load resistance | 20K Ω | |
| $R_H$ | Heater resistance | 33 Ω ±5% | Room Tem |
| $P_H$ | Heating consumption | less than 750mw | |

B. Environment condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Tao | Using Tem | -10℃-50℃ | |
| Tas | Storage Tem | -20℃-70℃ | |
| $R_H$ | Related humidity | less than 95%Rh | |
| $O_2$ | Oxygen concentration | 21%(standard condition)Oxygen concentration can affect sensitivity | minimum value is over 2% |

C. Sensitivity characteristic

| Symbol | Parameter name | Technical parameter | Ramark 2 |
|---|---|---|---|
| Rs | Sensing Resistance | 10K Ω - 60K Ω (1000ppm $CH_4$ ) | Detecting concentration scope: 200-10000ppm $CH_4$ , natural gas |
| α (1000ppm/ 5000ppm $CH_4$) | Concentration slope rate | ≤0.6 | |
| Standard detecting condition | Temp: 20℃±2℃ Humidity: 65%±5% | Vc:5V±0.1 Vh: 5V±0.1 | |
| Preheat time | Over 24 hour | | |

D. Strucyure and configuration, basic measuring circuit

| | Parts | Materials |
|---|---|---|
| 1 | Gas sensing layer | $SnO_2$ |
| 2 | Electrode | Au |
| 3 | Electrode line | Pt |
| 4 | Heater coil | Ni-Cr alloy |
| 5 | Tubular ceramic | $Al_2O_3$ |
| 6 | Anti-explosion network | Stainless steel gauze (SUS316 100-mesh) |
| 7 | Clamp ring | Copper plating Ni |
| 8 | Resin base | Bakelite |
| 9 | Tube Pin | Copper plating Ni |

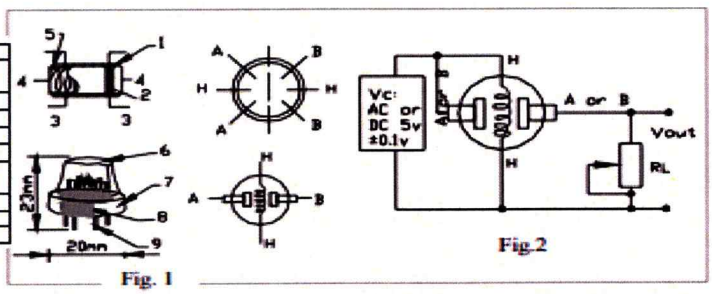
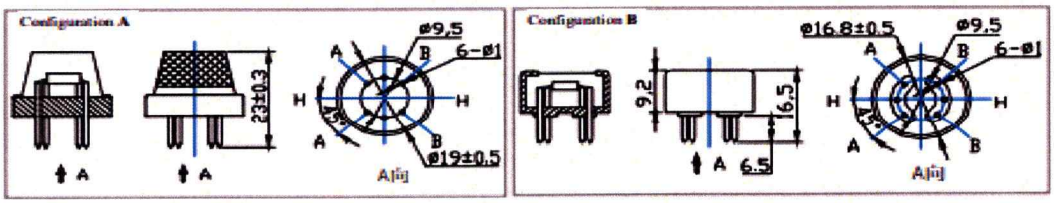



Fig.2

Fig. 1




TEL:86-371-67169080 FAX: 86-371-67169090 E-mail: sales@hwsensor.com