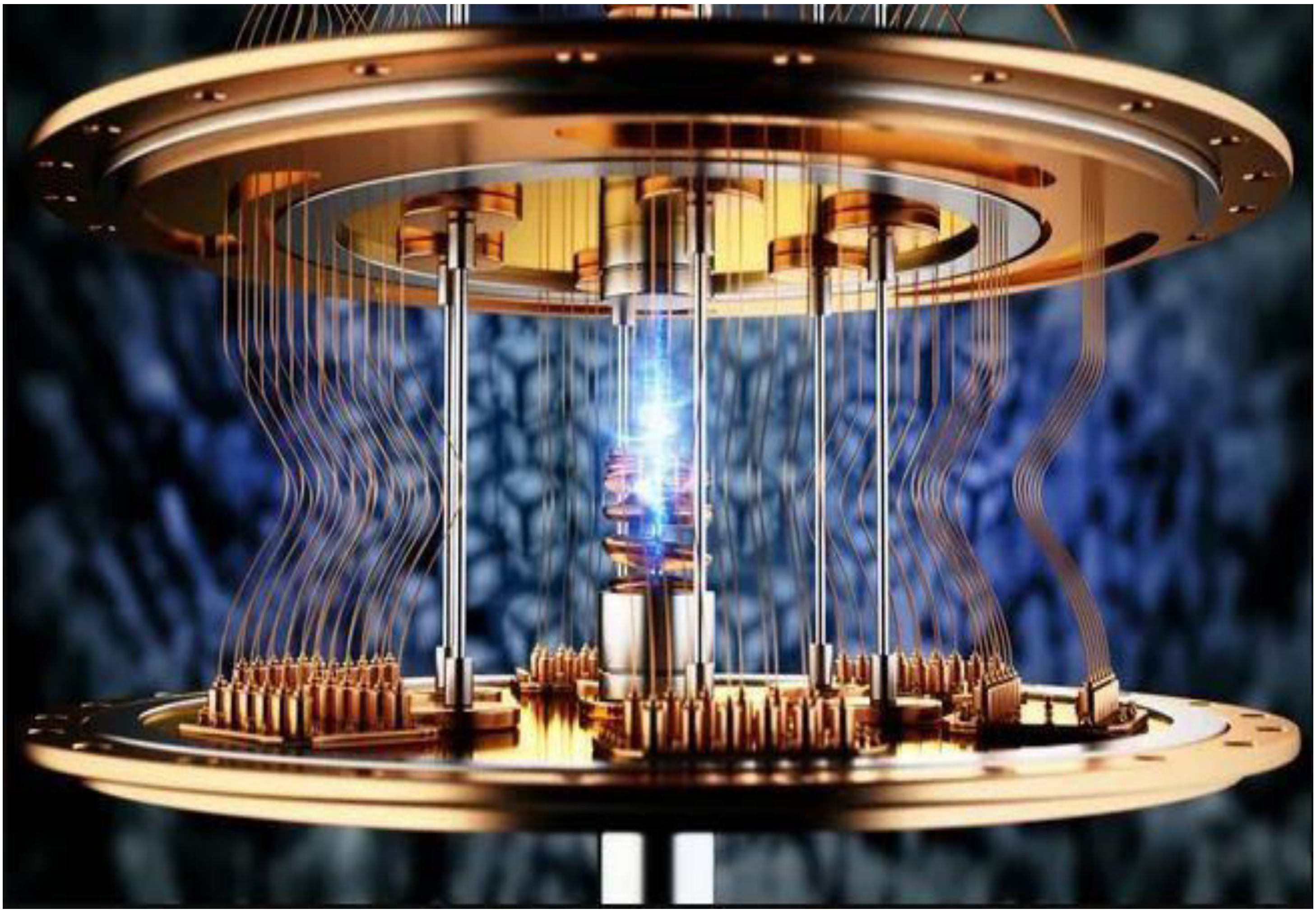
MAGAZINE

JANUARY- DECEMBER 2022

ECE SPECTRUM

Volume 03- (Yearly Technical Magazine)



ISO 9001 : 2015 Certified Institution

CODE:URCE

USHA RAMA

COLLEGE OF ENGINEERING AND TECHNOLOGY

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Approved by AICTE,

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ABOUT ECE DEPARTMENT

The Department of Electronics & Communication Engineering aims to impart value-based technical education and train students to become well-rounded engineers. Since its inception in the academic year 2008-09 with an initial intake of 60 students, the department has grown significantly. The current intake of the ECE department is 180 students. The department boasts faculty strength of 53 well-qualified, experienced, and dedicated postgraduates, including 11 doctorates, with some faculty members currently pursuing Ph.D.'s in various streams.

VISION OF THE DEPARTMENT

To be a pioneer in Electronics and Communication Engineering and research, promoting entrepreneurship and delivering innovative solutions to societal needs

MISSION OF THE DEPARTMENT

M1: To provide a strong foundation in Electronics and Communication Engineering, preparing students to tackle emerging technological challenges.

M2: To drive research in Electronics and Communication Engineering that delivers innovative solutions to societal needs.

M3: To promote lifelong learning, empowering students to adapt to the evolving technological advancements

Program Educational Objectives (PEO's):

The following are the Program Educational Objectives (PEO's) for Electronics & Communication Engineering Under-Graduate Program.

PEO 1: Exhibit continuous growth in technical expertise and leadership within the engineering field, while upholding professional ethics.

PEO 2: Communicate effectively and manage resources skillfully as members and leaders of the profession

PEO 3: Commit to continuous learning and adapt to emerging technologies to meet the evolving needs of society.

Program Specific Outcomes (PSOs):

PSO1: Develop electronics and communication systems in VLSI, embedded systems, signal processing, and RF communications using advanced tools.

PSO2: Apply ECE knowledge to design, develop, and test systems, considering societal, environmental, ethical, and economic factors.

Program Outcomes (POs):

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

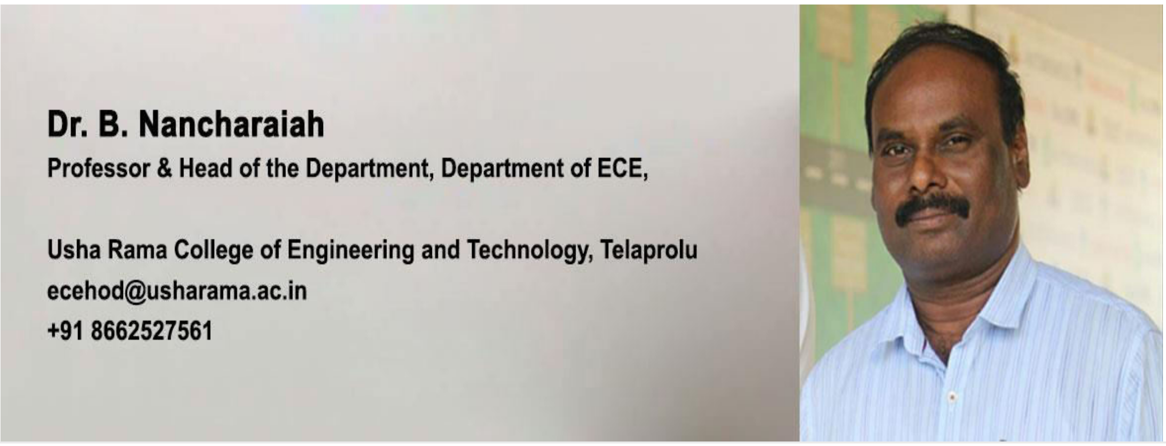
Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary setting.

MESSAGE FROM HOD



Dr. B. Nancharaiah received his B.E. degree in Electronics and Communication Engineering in 1999 from SRKR Engineering College, Bhimavaram, affiliated to Andhra University, India. He obtained his M.Tech degree in Electronics and Communication Engineering in 2003 from Pondicherry Engineering College, Pondicherry Central University, India. He earned his Ph.D. degree in Wireless Communications and Networks in 2017 from JNTUH, Hyderabad, India.

Dr.B.Nancharaiah has been working as Professor and HOD in the Department of Electronics and Communication Engineering at Usha Rama College of Engineering and Technology, Telaprolu, Andhra Pradesh, India, since June 2018. With 23 years of teaching experience, he is a Life Member of ISTE and Fellow of IETE. He has published over 70 papers in reputable national and international journals and conferences. He is the author of two textbooks: Metaheuristic Algorithms in Wireless and Mobile Ad Hoc Networks and Antenna and Wave Propagation. His research interests include wireless communications, networks, and IoTs.

Our department is committed to providing quality education and training to our students, enabling them to excel in their chosen careers. We strive to create a stimulating learning environment that fosters innovation, creativity, and critical thinking. Our faculty members are dedicated professionals with expertise in their respective areas, and we are proud of our strong industry partnerships that provide opportunities for internships, projects, and placements.

Best regards,
Dr.B.Nancharaiah
Head, Department of Electronics and Communication Engineering

Message from the Editorial Team

We are excited to present to you the third issue of the ECE Department's Technical Magazine for the academic year 2022-2023 .This editions is a reflection of the talent, dedication, and hard work of our students, showcasing their remarkable achievements in both co-curricular and extra-curricular activities.

The primary goal of this magazine is to highlight the innovative projects, research, and technical skills exhibited by our students. We believe that the exchange of knowledge and experiences plays a key role in shaping the future of technology and engineering.

We would like to extend our sincere gratitude to the Management and our esteemed Principal for their unwavering support and encouragement, which have been instrumental in the success of this initiative. We hope this magazine continues to inspire and inform, fostering a spirit of collaboration and innovation within the ECE department.

Chief Editor : Dr. B.Nancharaiah, Professor& HOD.

Faculty Advisors : Dr M.V.Srikanth , Dr.A.Suneel Kumar,Associate Professors.

Student Editors : A. Usha Ramya-II ECE Bhogadi Meghana- II ECE

1. Table of Contents:

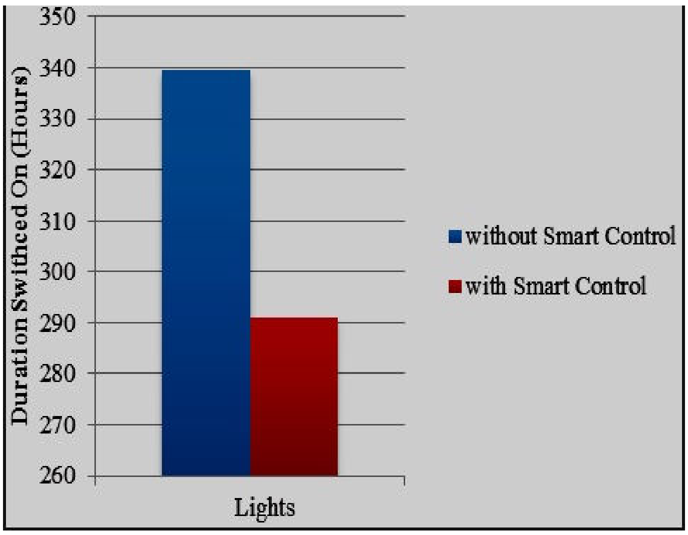
1. Based Smart Power Saving System for Home Automation

Abstract:

Manual control of home and office appliances like lights and fans often leads to power wastage. This paper proposes a smart, cost-effective system that uses a biometric door lock and an automated power-saving module. When a user is authenticated via fingerprint, the system activates and controls appliances based on room occupancy, temperature, and natural light levels—reducing unnecessary energy consumption.

Introduction:

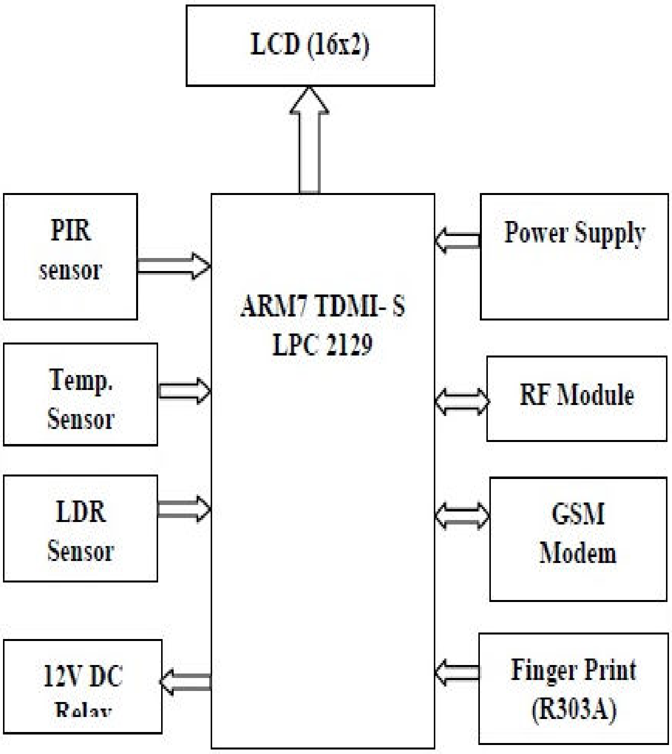
Home automation is still developing, with few affordable and effective solutions available. Smart control systems can reduce power consumption by around 18%



Many existing home automation systems use Bluetooth, Zigbee, or Wi-Fi, but they often rely only on motion sensing and can be costly. Our system improves accuracy by counting room occupants and adjusts appliance intensity based on daylight and temperature. It also uses low-cost RF modules, making it more affordable

Hardware Components of the System:

1. ARM7 TDMI-S LPC2129 – Main controller
2. DC Power Supply Unit – Powers the system
3. 16×2 LCD – Displays system status
4. LM35 Temperature Sensor – Measures room temperature
5. PIR Sensor– Detects human presence
6. OPT101 LDR Sensor – Measures ambient light
7. GSM Modem– Enables remote communication
8. RF Module – Wireless data transmission
9. Relays – Controls appliances
10. R303A Fingerprint Sensor– User authentication



Controller Unit

Uses ARM7 TDMI-S (LPC2148) microcontroller with 16/32-bit architecture, 128-256KB flash, 16KB RAM, 60MHz speed.

Includes peripherals: Temperature sensor (LM35), PIR sensor, Light sensor (OPT101), RF module, GSM modem (SIM300), fingerprint sensor (R303A), relay, 16x2 LCD, and power supply.

ARM7 LPC2129 Features

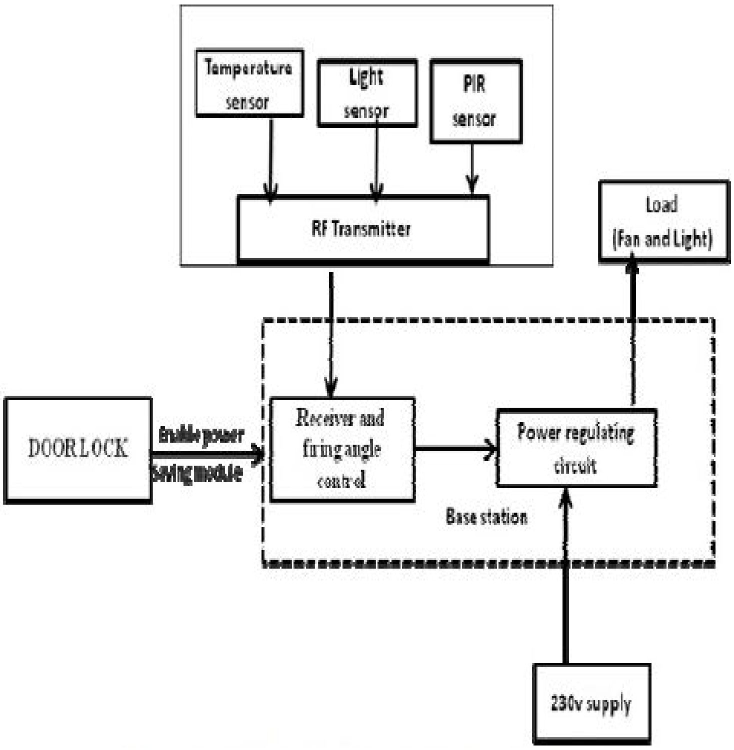
High-speed 60MHz, 16/32-bit, 128-256KB flash, 16KB RAM.

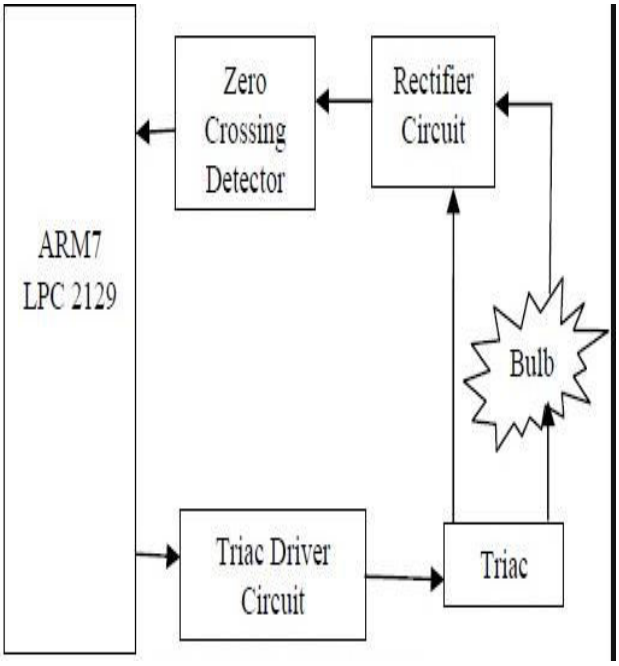
10-bit ADC, CAN interfaces ISP/IAP support.

RF Module

Operates at 433.92MHz, baud rate 1200-9600.

Simple connection, low power (3.3-5V), 250ft range.





PIR Sensor

Detects motion without contact, 5m x 5m range, 60° angle.

Low power, simple interface..

Relay

Electromagnetic switch controlling high-power devices with low power input.

Biometric Door Lock Fingerprint sensor (R303A) for secure door access based on fingerprint pattern matching.

Temperature & Light Sensors

LM35 and OPT101 provide analog outputs, converted via ADC for environmental monitoring

GSM Modem (SIM300)

Tri-band GSM module, supports SMS via AT commands.

Connected to microcontroller via UART.

Working

Door unlock via fingerprint verification or GSM control message.

Sensor data sent via RF to base station.

Power control via triac firing angle adjustment based on sensor input (temperature, light, occupancy).

Power Control Circuit

Zero-crossing detector triggers microcontroller interrupts.

Triac controlled via opt coupler (MOC3010) to adjust power delivery, saving energy.

Software Tools

Keil µVision4: IDE for embedded programming and debugging.

Flash Magic: Flash memory programming via ISP.

Embedded C: Programming language for embedded systems with hardware-specific extensions.

Conclusion

The smart control system effectively reduces power consumption, with every unit saved at the consumer end potentially saving two units at the power station. This highlights the importance and growing need for smart power-saving solutions. The implemented biometric door lock enhances security, and the system's components—microcontroller, sensors, and wireless modules—are affordable and readily available. This smart system is versatile and can be applied to areas like automated irrigation, industrial automation, and security systems.

2. Automated Car Parking System Controlled via Android Application

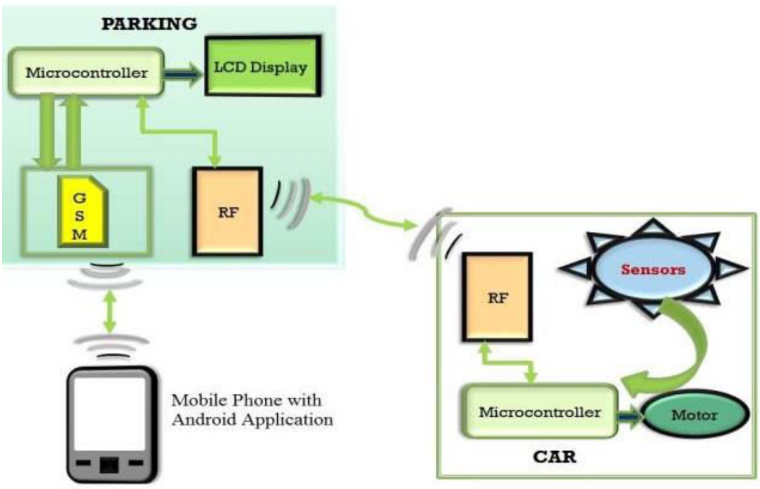
Abstract:

This paper proposes an Automated Car Parking System controlled via an Android app that automates parking and unpacking by managing available slots. Unlike existing systems that use limited automation like number plate recognition or mechanical lifts, this system minimizes human intervention by using sensors for path tracing. It reduces the time spent searching for free parking spaces and includes a mathematical model and results, with future improvements discussed.

Introduction:

Finding parking in busy places like malls and hotels is often time-consuming, especially in multi-storey lots. This system automates car parking by controlling the number of cars allowed based on space availability. Drivers stop at the entrance, use an Android app to check slot availability via SMS, and command the car to park or unpack it. The car follows sensor-guided paths to designated spots, updating an LCD display. This reduces the driver's effort and parking time**.**

System Architecture



The system has two main units:

1. Car Control Unit
2. Parking Control Unit

The Parking Control Unit is controlled by an Android app, which communicates with the Car Control Unit to manage car movements. The system has four main modules:

- LCD interfacing with Atmega32 for displaying parking status
- GSM Sim900 interfacing for SMS communication
- RF Module interfacing for wireless data transfer between Parking and Car units
- Android Application as the user interface for sending commands

Module Summaries:

1. LCD Interfacing:

A 20x4 LCD connected to Atmega32 displays parking slot status, updating the count of free slots using 4 data pins.

2. GSM Module:

GSM Sim900 sends and receives SMS commands between the Parking Control Unit and users via serial communication with Atmega32.

3. RF Module:

RF module (334 MHz) enables wireless communication between Parking Control Unit and Car Control Unit, transferring data via ‘Data in/out’ pins.

4. Android Application:

The app acts as a GUI to send SMS commands like “Status” and “Get my Car” to control parking operations.

Mathematical Model:

P: Set of Parking Areas {P1, P2, ..., Pn}

I: Set of slots {I1, I2... In}

ES: Set of empty slots

FS: Set of full slots, where ES and FS are subsets of I

S: Set of strip numbers for guiding turns

Directions of turn (0 = left, 1 = right)

A) Car

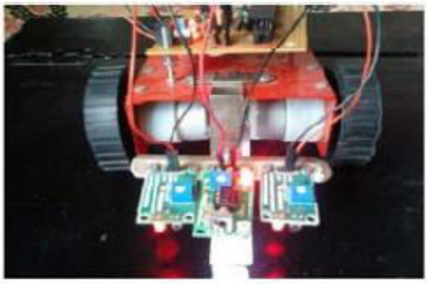
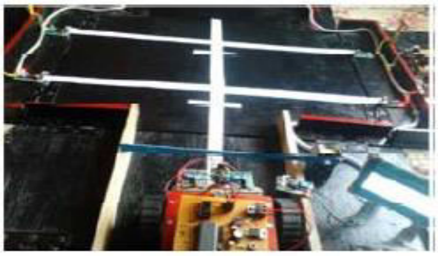
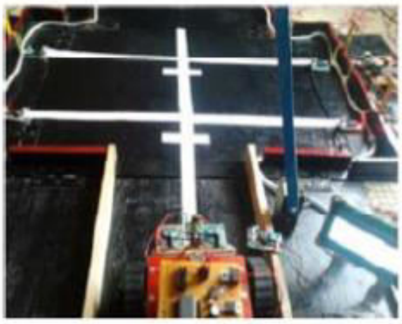


Figure 9.6: Car

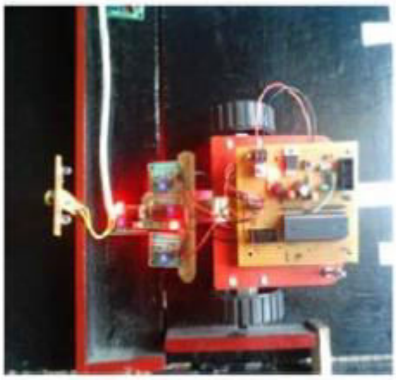
B) Car Arriving at the gate



C) Opening of Parking Gate



D) Car Parked



Conclusion

The paper successfully presents an Automated Car Parking System controlled via an Android app. The system components work efficiently and communicate effectively, making it suitable for commercial use. Future improvements include:

- Enhancing free slot search using Binary or Hash Search
- Extending the system to multi-level and multiple parking areas with hardware upgrades
- Securing SMS communication with encryption and adding user login for better security

3. Automated Soil Analysis System for Agriculture

Abstract:

Monitoring environmental factors is essential, especially in agriculture where temperature, moisture, and humidity impact crop selection and yield. Traditional soil testing in India is time-consuming, with millions of samples needing lab analysis. Soil analysis plays a crucial role in determining suitable crops and fertilizers. This paper presents a system using Arduino to analyze soil conditions and nutrient levels efficiently.

Introduction:

The automated soil testing device measures soil parameters like moisture, temperature, and humidity to assess fertility and recommend suitable crops and fertilizers. It uses sensors, a signal conditioning circuit, a microcontroller, and a wireless module to process and transmit data. Designed to be portable, economical, and user-friendly, it enables on-site testing without needing specialized personnel or lab visits. Automation ensures accurate, real-time data collection, improving agricultural decision-making and reducing manual effort.

Agricultural Monitoring System:

With growing awareness of technology in agriculture, automated systems are replacing manual data collection, which is often inaccurate and inconsistent. Wireless sensor nodes reduce labor, improve safety, enable real-time monitoring, and ensure data is not lost. These systems can track critical factors like temperature, humidity, soil moisture, light, and water level, improving crop yield and quality control.

Objectives:

Classify soil based on nutrient levels

Predict fertilizer response effectiveness

Recommend suitable fertilizers

Methodology:

Hardware: Arduino, LCD, Zigbee, Sensors

Software: Arduino IDE, HyperTerminal

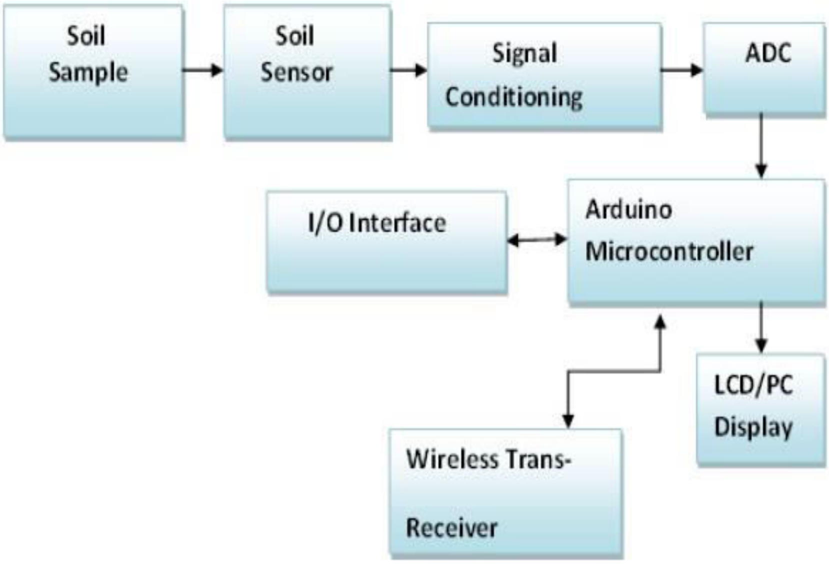
System Design:

Transmitter & Receiver:

Both include soil testing components to collect and transmit data wirelessly.

Block Diagram

Transmitter:



Receiver

Working Principle

The automated soil testing system allows farmers to test soil fertility by mixing 150g of soil with 60ml of water and placing sensors (copper electrodes) in the mixture. These sensors detect ionic content, converting it into electrical signals that are amplified, digitized via ADC, and processed by a microcontroller. The results, compared with pre-stored reference values, are displayed on an LCD and wirelessly transmitted for expert analysis. The system identifies soil fertility and recommends suitable crops. Results show varying soil parameters like moisture, temperature, pH, and humidity, which are compared with agricultural standards to guide crop selection. Future improvements include real field testing, integration of more sensor platforms, flood control, water usage audits, drying, weighing, sieving, and improved irrigation systems.

Component:

A. Arduino:

Main controller (5V, 40MHz); processes sensor data and compares with stored values.

B. LCD:

Displays soil data; receives and executes commands from Arduino.

B. ADC:

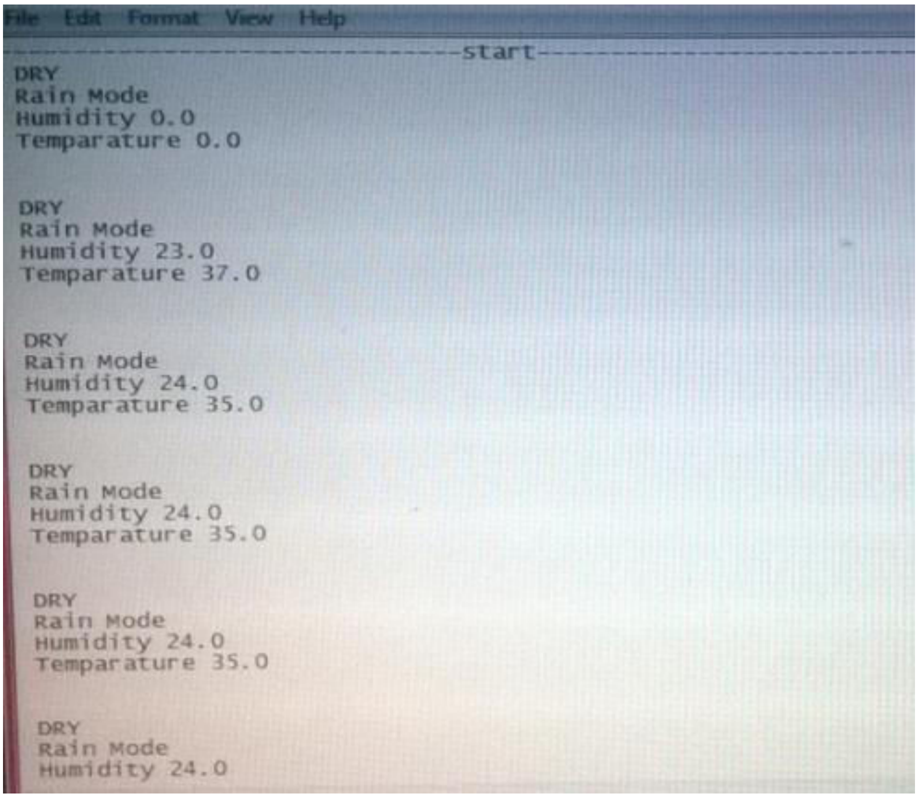
Converts analog sensor signals to digital for Arduino input.

C. Signal Conditioning:

Amplifies and filters weak sensor signals for accurate reading.

D. Sensors (Copper Electrodes):

Detect ionic particles in soil; convert to electrical signals.



Conclusion:

The soil testing device has been developed to analyze soil quality in agricultural fields. It measures real-time NPK (Nitrogen, Phosphorus, and Potassium) and pH values, which can vary between different soil types. These values are compared with pre-stored reference data from agricultural authorities to assess soil fertility. Additionally, the system suggests suitable crops for the tested soil. A wireless communication module is integrated to enable expert consultation and further analysis.

4. Motion Detection Alarm and Security System

Abstract:

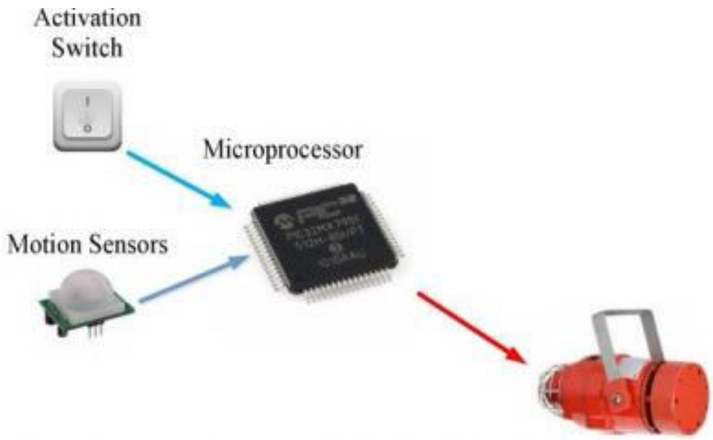
With the rise in burglaries, an effective and reliable intrusion detection system is essential. This project uses a passive infrared (PIR) sensor connected to a microcontroller to detect human motion based on body heat and trigger an alarm. The system is designed for home security and can also be applied to automation and energy efficiency. Initial testing shows it works as intended.

Introduction:

Security is vital for protecting life and property. As lifestyles get busier, remote control and surveillance of homes have become necessary. Motion detection alarms, once reserved for high-risk areas, are now widely demanded. The PIR sensor detects motion by sensing infrared changes, providing a compact, low-power solution compatible with common microcontrollers. The system includes an alarm and can be extended with cameras and other sensors to capture intruder images and enhance security. This cost-effective design offers reliable home protection with minimal maintenance.

Hardware and Software Design

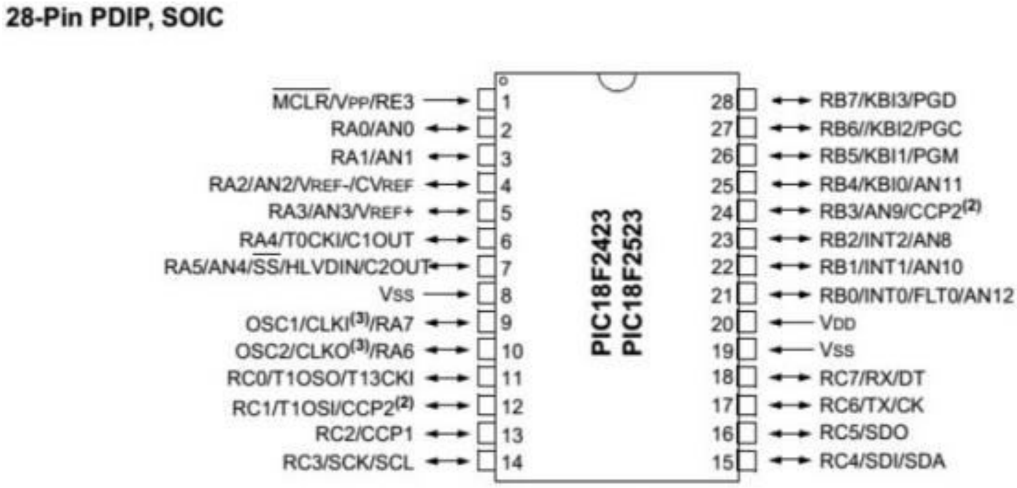
The motion detection alarm system is centered on the PIC18F2423 microcontroller, which controls inputs from PIR motion sensors and door switch sensors. The microcontroller operates at 4MHz and interfaces with LEDs for status indication and a relay to trigger an alarm siren. Power is supplied via a 5V regulator (LM7805).The PIR motion sensor detects human movement by sensing infrared radiation changes focused by a Fresnel lens. The alarm siren is a 12V, 15W horn buzzer producing a loud 110dB sound to alert occupants. Software is programmed in C using the CCS compiler. Upon startup, the system initializes and waits for user activation, then enters a security mode with a 60-second delay to allow exit.



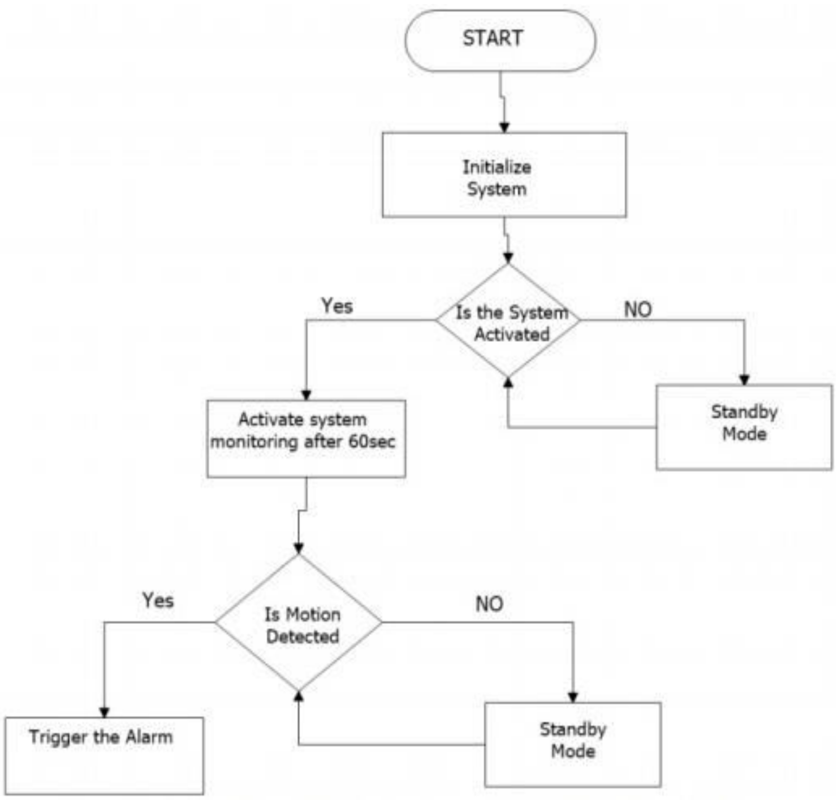
A Block diagram of the burglar alarm system

PIC18F2423 Microcontroller

The PIC18F2423 is a high-performance, low-power microcontroller from Microchip, featuring enhanced flash memory and nano-watt technology. This microcontroller includes 32KB of flash program memory, 10 channels of 12-bit analog-to-digital converters (ADC), three bi-directional I/O ports, and specialized capture/compare modules (CCP and ECCP).



Software Design Consideration



The flow chart for the program in the embedded processor

Constructed Device

The design was physically implemented on a PCB using surface-mounted components, soldered with a 30W iron. The completed system includes the PIR motion sensor and siren speaker.

Result

Initial testing with a continuity meter confirmed no short circuits. The sensors' sensitivity and all PCB components were verified. The system performed as expected both in open areas and when installed in a household, effectively detecting intruders via door switches and motion sensors.

Conclusion

The system was successfully tested and met design expectations. It offers a reliable, cost-effective security solution. Future enhancements could include adding audio-visual capabilities, such as capturing and emailing intruder images for improved security.

5. Smart, Dual-Controlled, Solar-Powered Robot for Pesticide and Fertilizer Spraying

Abstract:

With the growing population, modernizing agriculture is crucial. While industries have adopted advanced technology, farming still relies on outdated methods. This project develops a wireless, dual-controlled, solar-powered smart spraying machine for pesticides and fertilizers. Equipped with a tank and adjustable spray height, the machine aims to assist farmers by improving efficiency and reducing manual labor.

Keywords: Wireless, spraying, adjustable height, solar-powered.

Introduction:

India's rising population demands increased food production, making agricultural modernization essential. Traditional manual spraying of fertilizers and pesticides is labor-intensive and inefficient, leading to wastage and higher costs. Mechanized spraying ensures uniform application, reduces input waste, and lowers production costs. This project focuses on creating a dual-mode, solar-powered spraying machine to enhance productivity and reduce manual effort in pesticide and fertilizer application.

Objectives:

- Design a mobile machine carrying a pesticide/fertilizer tank for field use.
- Incorporate adjustable spray height to suit different crops.
- Ensure the machine can navigate various terrains.
- Power the machine using solar energy for sustainable operation.

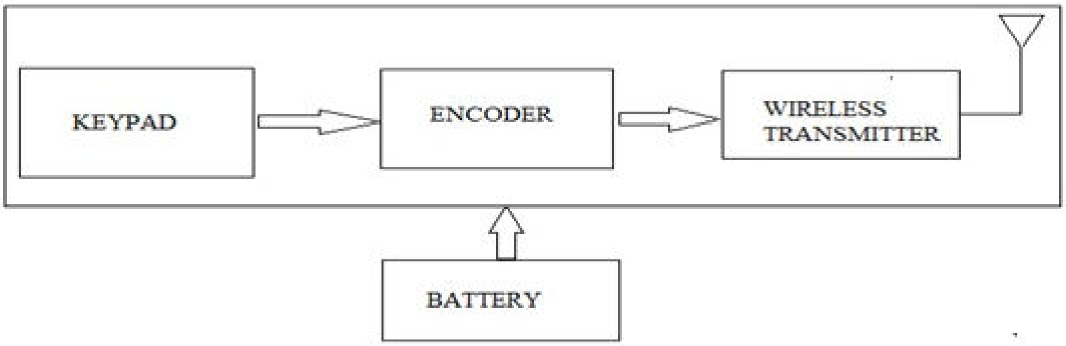
This project aims to replace manual spraying with a versatile, solar-powered, dual-controlled smart sprayer adaptable to any crop and field type.

Methodology:

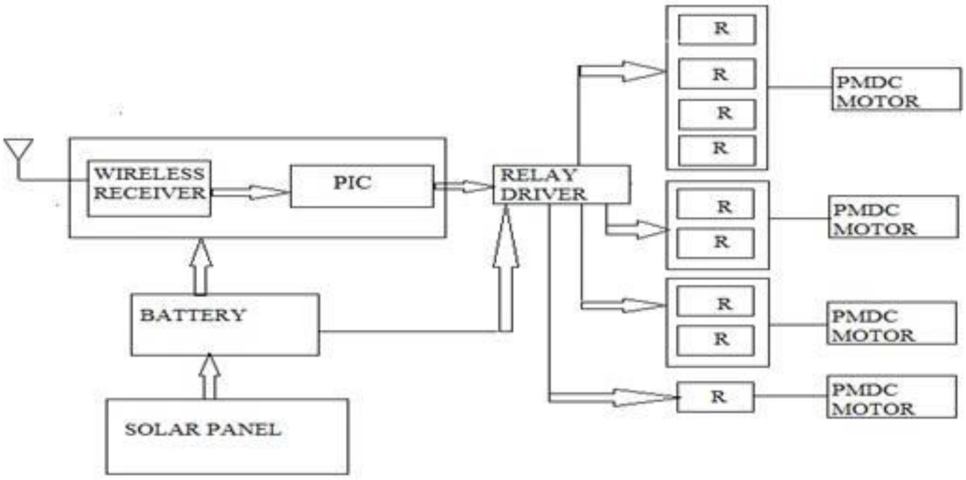
1. Mechanical Fabrication: Build a balanced 4-wheel frame with high-torque DC motors for movement.
2. Spray System: Install pesticide/fertilizer tank with a high-pressure pump for spraying.
3. Microcontroller Integration: Select and interface microcontroller with motor drivers for direction control.
4. Height Adjustment: Implement mechanically controlled spray height adjustment via actuators.
5. Solar Power System: Equip the machine with solar panels and charge controller for energy supply.
6. Assembly: Combine all components into a complete machine.
7. Testing & Optimization: Test the machine and optimize for best performance.

Block diagram

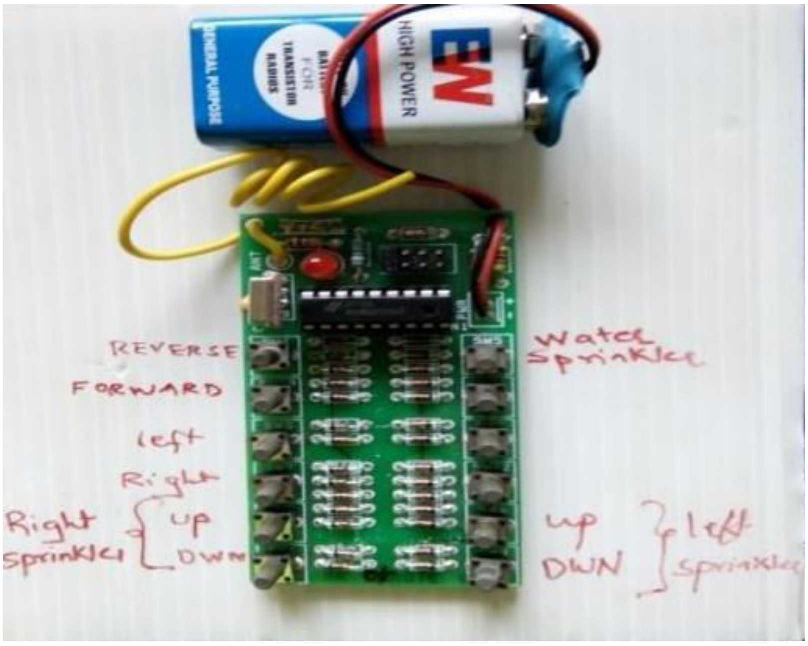
Transmitter:



Receiver:



Result and Tabulation



Robot Prototype

Merits:

- Wireless operation reduces health risks and physical labor.
- Minimizes manpower usage.
- Enables efficient, remote-controlled spraying via live feed.
- Suitable for all terrains

Demerits:

- Speed decreases on slippery, rainy terrain.
- Electronic components need proper protection from weather.
- The system is bulky.

Future Scope:

- Add wireless camera monitoring (FPV).
- Integrate Android control via Bluetooth.
- Implement SMS-based start/stop control.
- Develop GUI-based preprogrammed navigation.
- Enable crop-specific programming and navigation.

Conclusion:

Agriculture has evolved from manual labor to mechanization, improving efficiency. With rising food demands, fertilizer use has increased. Organic fertilizers require large volumes due to low nutrient concentration, making efficient application crucial. This project aims to modernize spraying methods, increasing productivity and reducing labor.

6. Solar Charger Circuit using the IC LM317

Abstract:

With rising fuel prices, solar energy is a popular alternative. Solar chargers are simple, portable devices ideal for remote areas. Since solar panels don't provide regulated voltage, this project uses an adjustable voltage regulator and a zener diode to ensure safe, efficient battery charging by cutting off at full charge.

Introduction:

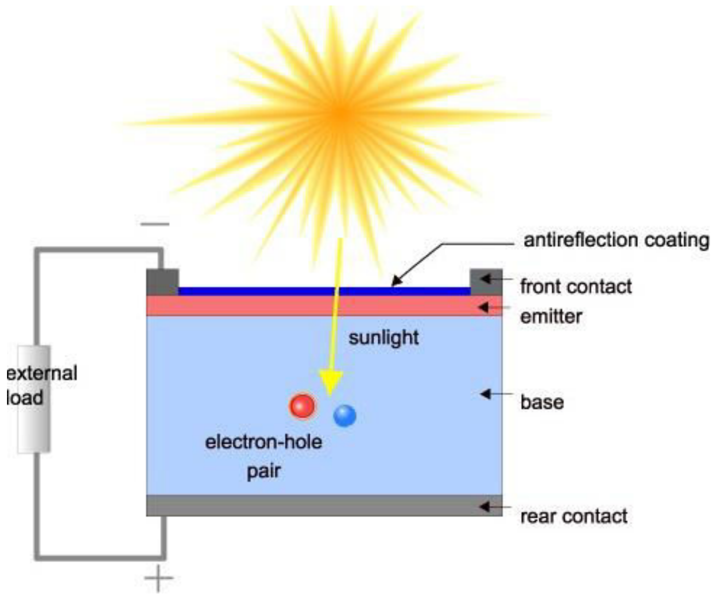
Solar cells convert sunlight directly into electricity and are becoming smaller, cheaper, and more efficient. The sun provides far more energy than humans need, making solar power a sustainable alternative to fossil fuels. Using solar energy can reduce carbon emissions and reliance on fuel.

Solar Charger:

Solar panels consist of many solar cells that generate electricity when sunlight frees electrons in their silicon-based p-n junction. Panels come in types like monocrystalline, polycrystalline, and amorphous, each varying in efficiency and cost. Solar chargers store this energy in batteries to provide power when the sun isn't shining.

Additional Info on Solar Panels:

Monocrystalline panels are the most efficient due to pure silicon crystals, polycrystalline panels have lower efficiency with multiple crystal boundaries, and amorphous thin-film panels are the cheapest but least efficient. Choice depends on balancing cost and performance.

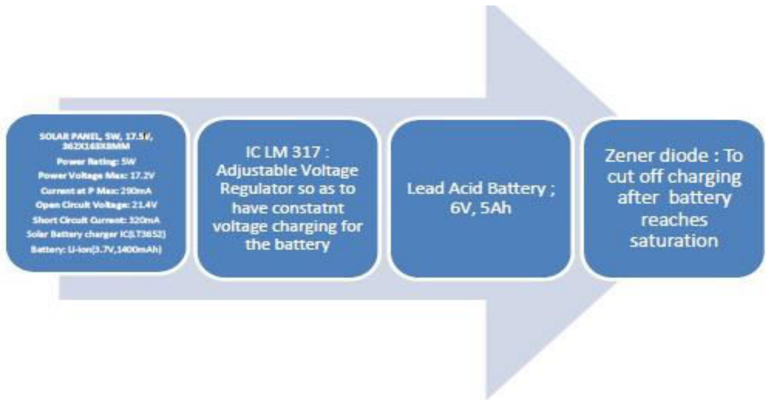


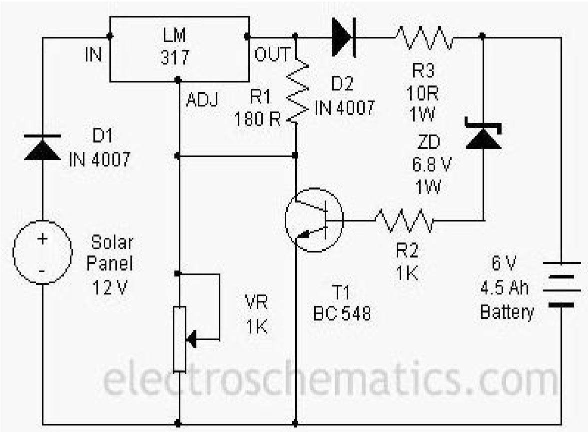
Need for Solar Chargers:

Because solar panels only work during daylight, solar chargers store energy in batteries to provide power anytime. This project uses the LM317 voltage regulator to charge a lead-acid battery safely. Advanced ICs with MPPT improve efficiency but are more complex.

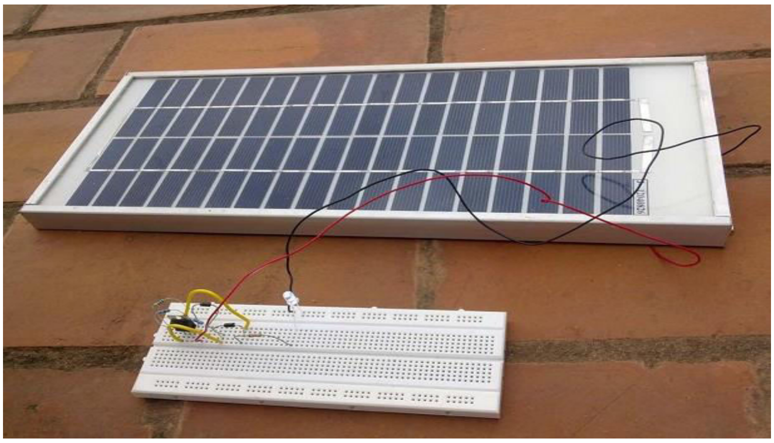
Theory

This project uses an **LM317 adjustable voltage regulator** to create a solar charger for a 6V sealed lead-acid battery powering a solar lamp. The solar panel (17.4V, 0.33A, 5W) provides unregulated voltage, so the LM317 ensures a steady charging voltage to protect the battery. Blocking diodes prevent battery discharge at low sunlight, while a zener diode and transistor cutoff circuit stop charging when the battery is full.





Solar Charger with Current regulation and Cut off



Experiments

1. Solar Panel Behavior: Voltage output varies with light intensity (0.2V to 21.2V), showing sunlight greatly affects power generation.

2. LM317 Regulation: Tested with resistors R1=180Ω and R2=500Ω, LM317 maintains stable output voltage over varying input voltages (2.1V to 20V).

Conditions	Open circuit voltage across the panel
Covered with cardboard	0.263V
Facing the desk	0.468V
Covered with Paper	2.5V
At the window(11am)	14.72V
In the lab	7.62V
At the desk	5.2V
Using a torchlight at distance 15cm	11.22V
At the terrace(2pm)	21.2V(maximum Voc=21.4V)

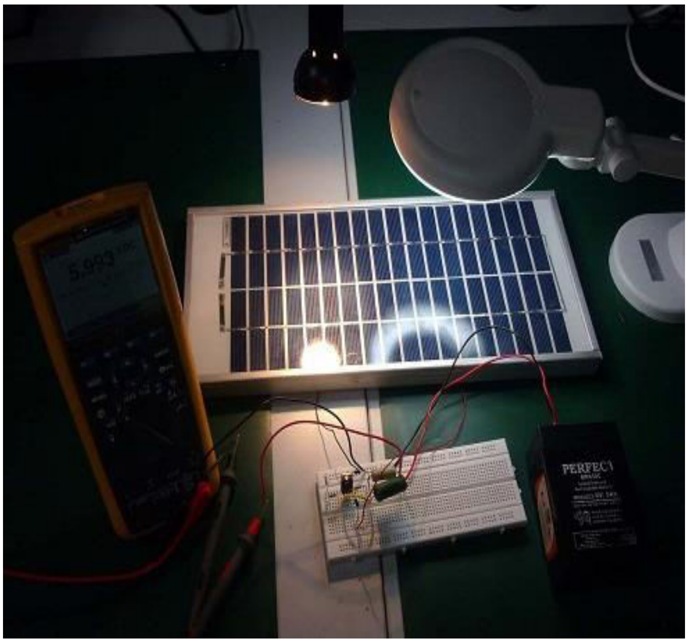
- **To analyze the operation of the IC LM317 using a power supply.**

Vin	Vref	Vout	Vin-Vout	Iref(mA)	Iadj(uA)
6.85V	1.225	4.64V	2.12V	6.81	19
8.30V	1.225	4.657V	3.67V	6.815	53
10.59V	1.224	4.65V	4.65V	6.815	46.6
12.16v	1.225	4.667V	4.667v	6.81	73
15.68V	1.225	4.68V	11.00V	6.81	99
23.67V	1.225	4.651V	18.19V	6.817	41

Using Solar panel

Conditions: R1=180Ohm, R2=500ohm

Vin	Vref(V)	Vout	Iref(mA)	Iadj(uA)
4.85V	1.225	4.64V	6.81	19
6.30V	1.225	4.657V	6.815	53
7.59V	1.224	4.65V	6.815	46.6
8.16v	1.225	4.667V	6.81	73
10.68V	1.225	4.68V	6.81	99
11.67V	1.225	4.651V	6.817	41



Summary

- Solar energy is clean and vital for sustainable living.
- Solar panels power the circuit and feed into a voltage regulator for constant battery charging.
- Batteries store energy; chargers focus on charging batteries, not direct loads.
- Different rechargeable batteries exist; this project uses sealed lead-acid batteries.

Conclusion

- Solar panels provide \~12V in bright sun but with unregulated voltage.
- LM317 regulates voltage but wastes about 2V, affecting efficiency.
- Voltage regulators are essential for safe, constant battery charging.
- Zener diode ensures charging stops at full battery voltage.
- The circuit is a simple, practical lead-acid solar charger ideal for portable use.

7. Analysis and Classification of Milk Quality Using Electronic Sensory Organs

Abstract:

Milk is a nutritious fluid from mammals, but its quality is often compromised due to adulteration, especially by local vendors. This project proposes a system to detect milk adulteration using electronic sensors — an electronic nose (odor), electronic tongue (taste/conductivity), pH sensor, and temperature sensor — integrated with a PIC18F4520 microcontroller. These sensors collectively analyze milk quality and display results on an LCD, helping prevent health risks and supporting fair trade practices.

Introduction:

Milk provides essential nutrients like fats, proteins, vitamins, and minerals. Its composition varies based on breed, diet, and environmental factors. Milk adulteration alters its physical and chemical properties, which can be detected through parameters such as pH, temperature, odor, and taste. Ensuring milk quality is critical for public health and consumer rights.

Objective:

- Detect adulterants in milk using:
    - **PH sensor** – Monitors spoilage or contamination.
    - **Electronic nose** – Detects foul odors due to toxins or spoilage.
    - **Electronic tongue** – Identifies taste changes caused by adulterants.

Methodology:

The system analyzes milk quality based on four modules:

1. **PH Measurement** – Ideal range: 6.5–6.7.
2. **Temperature Check** – Safe range: 35–40°C.
3. **Odor Detection** – Uses gas sensor to identify spoilage gases.
4. **Taste/Conductivity** – Detects chemical imbalances due to adulteration.

Hardware Components:

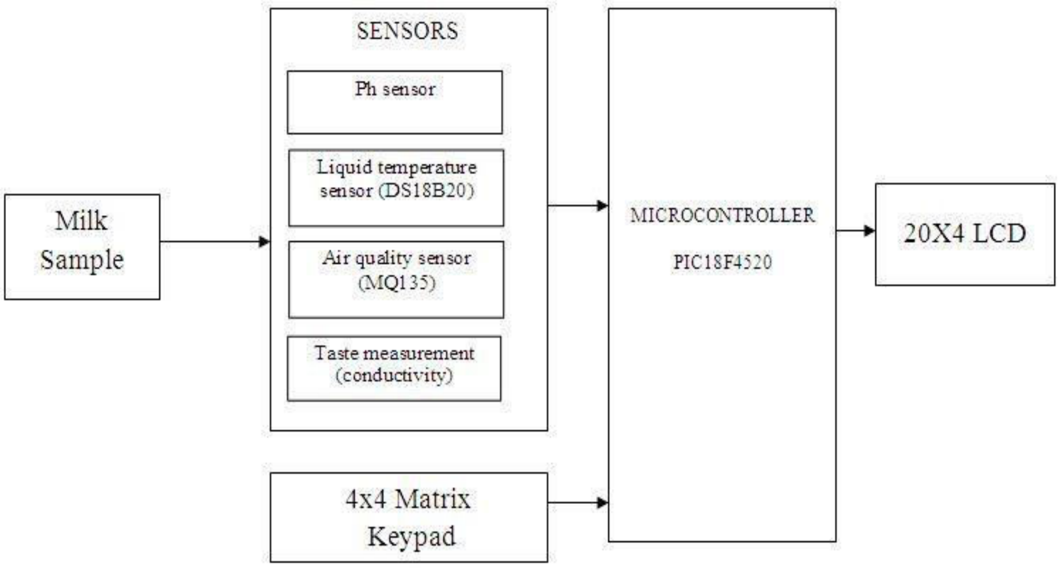
- PIC18F4520 Microcontroller
- BNC SL-31 pH Sensor
- DS18B20 Temperature Sensor
- MQ135 Air Quality Sensor
- Conductivity Sensor
- 20x4 LCD Display
- 4x4 Keypad
- 7805 Voltage Regulator

Software Tool:

- **MPLAB X IDE** – Coding in Embedded C
- **PIC KIT 2** – Flashing the microcontroller
- **PROTEUS** – Circuit simulation

Block Diagram

Sensors (pH, temperature, odor, and taste) collect data from the milk sample. The PIC18F4520 processes this data and determines milk quality, which is then displayed on an LCD.

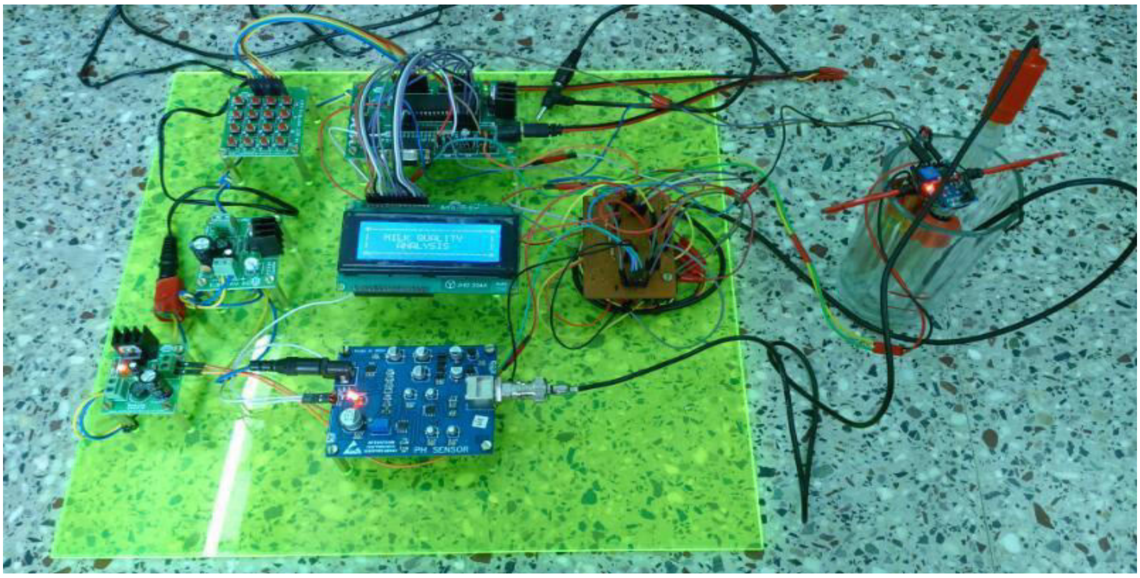


Results:

The proposed system was successfully implemented into a working model (Fig.2). Sensor data was calibrated and analyzed to classify milk into quality grades. The system detects adulterants like **sugar**, **salt**, **soap**, and **H_2O_2**, with operations controlled via a **hex keypad** and results displayed on an **LCD screen**.

The system performs the following tests:

1. **Freshness Test** – Determines if the milk is fresh and suitable for further testing.
2. **Grade Test** – Classifies milk into five grades based on quality, taste, and odor.
3. **Adulteration Test** – Identifies specific adulterants present in the sample.



Advantages:

- Compact and suitable for small-scale industries
- Detects adulterants (sugar, soap, salt, H_2O_2) undetectable by lactometer
- Easy to use, low cost, and energy efficient
- Fast results and minimal maintenance
- Ideal for rural and small dairy applications

Disadvantages:

- Limited to milk testing only
- Requires calibration after ~50 tests
- Sensor cost varies with accuracy needs

Applications:

- Used in small dairies for quality checks
- Helpful for farmers, consumers, and milk traders
- Personal use for daily milk quality monitoring

Conclusion:

The Milk Quality Analysis System using electronic sensory organs provides an efficient, low-cost, and reliable solution to detect milk adulteration. It ensures accurate classification based on pH, temperature, odor, and taste. The system is user-friendly, reduces human error, and helps prevent health hazards. With further improvements, it can play a vital role in ensuring milk quality for consumers, especially in rural and small-scale dairy sectors.