COMMUNITY CONNECT REPORT

[21GNP301L]

SMART TOILET SYSTEM USING IOT

SUBMITTED BY

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SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

TIRUCHIRAPPALLI-621105

NOVEMBER 2024

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, TRICHY
COLLEGE OF ENGINEERING AND TECHNOLOGY

REGISTER NO._____

BONAFIDE CERTIFICATE

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Register No: ---------- of **III/V** (Year/Semester), **B.Tech ECE** Programme in the project-based course **21GNP301L, Community Connect** at **SRM Institute of Science and Technology, Tiruchirappalli** during the Academic Year 2024-2025.

Faculty In-charge **Head of the Department**

Submitted for the End Semester Examination held on _____

Examiner 1 **Examiner 2**

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CONTENTS

CERTIFICATES:

SRI SAI SARAN TRUST

NO 131, AMMA MANDABAM ROAD, SRI RANGAM, TIRUCHIRAPPALLI-620006

Reg 35/2018 -Darpan TN/2018/0206102

CERTIFICATE OF COMPLETION

This certificate is to certify:

M S SAISANKEET

Of Third Year B.TECH-ECE Currently Studying at SRM INSTITUTE OF SCIENCE AND TECHNOLOGY,TRICHY Has Participated And Successfully Completed NGO Social Activities As Part Of Community Connect Course For A Duration Of 4Weeks In The Month Of June 2024

For SREE SAI SARAN TRUST

S. Sumathi

MANAGER

Manager

Sri Sai Saran Trust

SRI SAI SARAN TRUST

NO 131, AMMA MANDABAM ROAD, SRI RANGAM, TIRUCHIRAPPALLI-620006

Reg 35/2018 -Darpan TN/2018/0206102

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BALAJI G

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For SREE SAI SARAN TRUST

S. Sumathi

MANAGER

Manager

Sri Sai Saran Trust

SRI SAI SARAN TRUST

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Reg 35/2018 -Darpan TN/2018/0206102

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For SREE SAI SARAN TRUST

S. Sumathi

Manager

Sri Sai Saran Trust

MANAGER

SRI SAI SARAN TRUST

NO 131, AMMA MANDABAM ROAD, SRI RANGAM, TIRUCHIRAPPALLI-620006

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For SREE SAI SARAN TRUST

S. Sumathi

MANAGER

Manager

Sri Sai Saran Trust

PROBLEM STATEMENT:

It's based on hygiene issues.

Maintaining hygiene in restrooms is a significant concern, especially for elderly individuals who may struggle with mobility and awareness. Traditional methods of ensuring toilet cleanliness are often insufficient, leading to unhygienic conditions. This project aims to develop an affordable, automated system using an IoT device to detect dirt and prompt immediate cleaning, enhancing hygiene and promoting awareness.

GEO TAGGED PHOTOS

NGO DETAILS

- **SREE SAI SARAN TRUST**

ADDRESS : 3131, AMMA MANDABAM ROAD, SRI RANGAM, TIRUCHIRAPPALLI-620006

DOMAIN

Aged/Elderly

Rural Development & Poverty Alleviation

Health & Family Welfare

Woman's Development & Empowerment

TYPE OF ORGANISATION

Non-Profit Trust

Sr No.	Name of VO/NGO	Registration No.,City & State	Address	Sectors working in
1	SREE SAI SARAN TRUST	35/2018, SRI RANGAM, TAMIL NADU	3131, AMMA MANDABAM ROAD, SRI RANGAM, TIRUCHIRAPPALLI620006	Children,Aged/Elderly,Health & Family Welfare,Rural Development & Poverty Alleviation,Women's Development & Empowerment

REGISTRATION DETAILS

NGO Darpan
TN/2018/0206102
Region : India

Sub-Registrar
35/2018
Region : India Tamil Nadu
Date: Monday, July 2, 2018

TEAM

Chief Functionary
J K PREMALATHA

Treasurer
V UMAMAHESWARI

Trustee
GOWRI BHASKARAN

1. INTRODUCTION:

The "Smart Toilet System for Old Age People Using IoT" is a technological innovation aimed at enhancing the quality of life for elderly individuals by addressing their specific hygiene and health needs. With the increase in aging populations globally, the demand for systems that cater to their unique requirements, such as mobility constraints, chronic health conditions, and the need for privacy, has become paramount.

The proposed smart toilet integrates IoT (Internet of Things) technology to provide automated features such as self-cleaning, health monitoring, fall detection, and emergency alerts. Sensors embedded in the system can measure vital signs (e.g., glucose levels, blood pressure) through urine analysis and send real-time data to caregivers or healthcare providers. Additionally, voice commands and app-based controls make the system highly user-friendly for elderly individuals with limited physical dexterity.

This solution not only supports independent living but also reduces the burden on caregivers and healthcare systems by providing early health alerts and minimizing the need for constant supervision.

1.1 Relevance to Sustainable Development Goals (SDGs)

The Smart Toilet System aligns with several SDGs, particularly:

a) SDG 3: Good Health and Well-Being
By integrating health monitoring capabilities, the system ensures timely detection of potential health issues such as urinary infections, diabetes, or kidney diseases. This promotes early intervention and enhances overall well-being.

b) SDG 9: Industry, Innovation, and Infrastructure
The system exemplifies the use of innovative technology and sustainable design to create a product that addresses a critical societal need. The use of IoT reflects advancements in smart infrastructure tailored for aging populations.

c) SDG 12: Responsible Consumption and Production
Materials and features like water-saving technologies, recyclable components, and energy-efficient designs contribute to sustainable consumption patterns.

d) SDG 11: Sustainable Cities and Communities
The system fosters inclusivity by improving accessibility for elderly individuals in urban and rural communities, ensuring they can maintain dignity and independence.

1.2 Level of Innovation

The Smart Toilet System represents a convergence of multiple cutting-edge technologies:

1. **IoT Integration**: Sensors, actuators, and communication modules enable real-time monitoring and automation, providing personalized assistance and health insights.
2. **Health Monitoring Features**: Incorporates non-invasive techniques like urine analysis and motion sensors for fall detection, a novel approach to elderly care.
3. **AI-Powered Insights**: Utilizes artificial intelligence to analyze data trends, predict health risks, and recommend preventive measures.
4. **Accessibility and Usability**: Features such as voice command compatibility, mobile app integration, and ergonomic design ensure ease of use.
5. **Sustainability**: Incorporates water-saving flushing mechanisms and uses materials that are eco-friendly and durable.

This system goes beyond traditional elderly care solutions, offering proactive and preventive health management while ensuring user comfort and safety.

1.3 Use of Materials

The selection of materials focuses on durability, hygiene, and environmental sustainability:

1. **Primary Materials**:
    - **Ceramic and Porcelain**: For the toilet bowl, ensuring long-term durability and easy cleaning.
    - **Stainless Steel**: For components like handrails and fittings, providing rust resistance and support for mobility.
2. **Sensors and Electronics**:
    - **Biochemical Sensors**: For analyzing urine and other health parameters.
    - **Infrared Sensors**: For touchless operation of flushing and cleaning mechanisms.
    - **Pressure Sensors**: To detect occupancy and prevent accidental misuse.
3. **Additional Features**:
    - **Water-Efficient Components**: Dual-flush systems to reduce water consumption.
    - **Smart Modules**: Energy-efficient microprocessors and IoT communication modules.

- **Antimicrobial Coatings**: To prevent bacterial growth on frequently touched surfaces.

4. **Sustainable Elements**:
    - **Recycled Plastics**: For casing and non-load-bearing parts.
    - **Energy-Efficient Power Sources**: Integration with solar-powered batteries or low-energy IoT devices.

By utilizing sustainable materials and advanced technology, the Smart Toilet System balances innovation with environmental responsibility.

2. PROPOSED SOLUTION

2.1 Proposed Solution with Community Involvement

The "Smart Toilet System for Old Age People Using IoT" is designed to address both individual needs and broader societal challenges. The proposed solution involves:

2.1.1 Key Features:

- **IoT-Enabled Health Monitoring**: Equipped with sensors for urine analysis (e.g., glucose, protein levels) and motion detection for fall alerts. Data is transmitted securely to caregivers and healthcare providers.
- **Hands-Free Functionality**: Automated flushing, self-cleaning, and voice-command features ensure ease of use for elderly individuals with mobility challenges.
- **Emergency Response System**: Integrated with an alert mechanism to notify family members, caregivers, or local health authorities in case of emergencies.
- **Sustainability Features**: Water-saving flush mechanisms, solar-powered components, and the use of recycled materials.

2.1.2 Community Involvement: The success of this system depends on active participation from the community. Key elements include:

- **Community Awareness Drives**: Educating communities about the benefits of adopting smart sanitation solutions, especially for elderly care.
- **Feedback Mechanisms**: Involving elderly individuals and caregivers in the design and testing phases to ensure the system meets their needs.
- **Training Programs**: Partnering with local communities to train volunteers on installation, usage, and maintenance of the system.

Local Partnerships: Working with community health centers to monitor and utilize health data for preventative care.

2.2 Features of Community Work and the Role of NGOs

To implement this solution effectively, community work and collaboration with NGOs are crucial.

2.2.1 Community Work:

- **Installation Support**: Community members can assist in setting up the system, especially in underserved areas where plumbing and electricity might need upgrades.
- **Maintenance Teams**: Forming local teams trained to troubleshoot and repair the system ensures long-term sustainability.
- **Data Utilization**: Collaborating with community healthcare workers to use the health data collected for preventive healthcare initiatives.
- **Workshops and Awareness Sessions**: Regular community meetings to promote the adoption of the technology, share experiences, and encourage its wider use.

2.2.2 Role of NGOs:

- **Fundraising and Grants**: NGOs can secure funding from donors or government schemes focused on elderly care, health, and sanitation.
- **Pilot Programs**: NGOs can implement the solution in pilot locations, gather data, and refine the model before large-scale deployment.
- **Advocacy and Policy Support**: NGOs can advocate for the inclusion of smart sanitation solutions in national health and eldercare policies.
- **Volunteer Mobilization**: Mobilizing volunteers to provide training, assist with installations, and help elderly individuals adapt to the technology.

2.3 Milestones and Timelines

A phased approach ensures efficient implementation. The milestones and estimated timelines are as follows:

Phase 1: Research and Development (0–6 Months)

- Conduct user research to understand elderly needs.
- Finalize system design and select suitable IoT sensors and materials.
- Develop a prototype and test its functionality.

Phase 2: Pilot Testing and Feedback (6–12 Months)

- Install the system in 50–100 homes in a pilot community with NGO collaboration.
- Gather user feedback to identify pain points and areas for improvement.

- Conduct awareness workshops for community members and caregivers.

Phase 3: Community Scaling (1–2 Years)

- Refine the product based on pilot feedback.
- Expand installation to additional communities, prioritizing underprivileged areas.
- Train local technicians for maintenance and system updates.

Phase 4: Integration with Health Systems (2–3 Years)

- Partner with local clinics and healthcare providers for seamless data integration.
- Analyze collected health data for public health insights and preventative measures.
- Establish partnerships with government bodies to support large-scale adoption.

Phase 5: Nationwide Rollout (3–5 Years)

- Work with NGOs and government bodies to expand the solution nationally.
- Launch advocacy campaigns to include smart toilets in eldercare policies.
- Ensure ongoing technical support and community engagement for sustainability.

3. DESIGN AND DEVELOPMENT

3.1 Design and Development with Reference to Technical and Hardware Implementation

3.1.1 Design Overview

The design of the Smart Toilet System for elderly individuals focuses on usability, safety, and health monitoring. The system integrates IoT components with conventional sanitary hardware to provide a seamless, user-friendly experience. The design includes:

- **Smart Monitoring Unit**: Sensors for urine analysis and weight measurement.
- **User Interaction Module**: Voice-controlled commands and a mobile app.
- **Safety Features**: Fall detection sensors and emergency alert systems.
- **Sustainability Features**: Water-efficient flushing and solar power options.

3.2 Technical Implementation

a) IoT Integration:

- **Sensors**:
    - Biochemical sensors for urine analysis (glucose, protein, pH).
    - Pressure sensors to detect occupancy and monitor user weight.

    - Infrared sensors for touchless flushing and lid opening/closing.
- **Microcontroller**: An IoT microcontroller like **ESP32** or **Raspberry Pi Pico W** for data collection and communication.
- **Connectivity**: Wi-Fi and Bluetooth modules for seamless integration with mobile apps.

b) Software Development:

- **Mobile App**: A user-friendly app to provide health insights, system alerts, and control features (e.g., flushing, lid adjustment).
- **Cloud Integration**: Storing health data securely for caregiver and doctor access.
- **AI and Analytics**: Machine learning algorithms to detect anomalies and predict health risks based on sensor data.

c) Hardware Implementation:

- **Ergonomic Design**:
    - Toilet with adjustable height to accommodate users with mobility issues.
    - Built-in handrails for safety.
- **Self-Cleaning Mechanism**: A combination of UV sterilization and automatic water jet cleaning.
- **Power Supply**: Dual-mode operation using a rechargeable battery and solar panels.

3.3 Development Stages

1. **Prototype Design**: Fabricating a prototype using off-the-shelf components.
2. **Testing and Debugging**: Conducting rigorous testing to ensure sensor accuracy and system reliability.
3. **Pilot Installation**: Deploying the system in a controlled environment for real-world feedback.
4. **Product Refinement**: Addressing user feedback and improving the design.

3.4 PROPOSED BUDGET

S.No	COMPONENTS	PRICE
1.	MICROCONTROLLER	400
2.	IR SENSOR	40
3.	GAS SENSOR	50
4.	RFID (Optional)	120
5.	BUZZER	40
6.	GSM	450
7.	LED	50
8.	SONIC SENSOR	150
9.	FIGARO SENSOR	1500
	TOTAL	**2,800**

3.5 COMPONENTS DISCRIPTION

Microcontroller

- **Function:** Acts as the brain of the system, controlling all sensors, components, and communication.
- **Example:** Arduino, ESP32, or Raspberry Pi.
- **Integration:**
    - Collects data from sensors.
    - Processes and triggers responses (e.g., activating alarms or sending messages).

IR Sensor (Infrared)

- **Function**: Detects presence or motion.
- **Use Case**:
    - Detect when the toilet seat is occupied or if someone enters/exits the area.
    - Helps in automating LED lighting or safety alarms.

Gas Sensor

- **Function**: Monitors harmful gases (like ammonia or methane) or odor levels.
- **Use Case**:
    - Alerts if there are hazardous gas levels in the restroom.
    - Ensures ventilation systems operate when needed.

RFID (Optional)

- **Function**: Identifies users or restricts access.
- **Use Case**:
    - Customizes toilet settings for individuals (e.g., elderly users with special needs).
    - Restricts unauthorized access in shared or institutional setups.

Buzzer

- **Function**: Provides an audio alert.
- **Use Case**:
    - Alerts caregivers if an elderly person has fallen, remains inactive for too long, or if gas levels are unsafe.

GSM Module

- **Function**: Enables communication through SMS or calls.
- **Use Case**:
    - Sends emergency alerts to caregivers or medical services.
    - Can notify about maintenance issues or unusual activity.

LED

- **Function**: Visual indicators.
- **Use Case**:
    - Status indicators (e.g., system on/off, hazard detected).
    - Guides elderly users with light cues in low-light conditions.

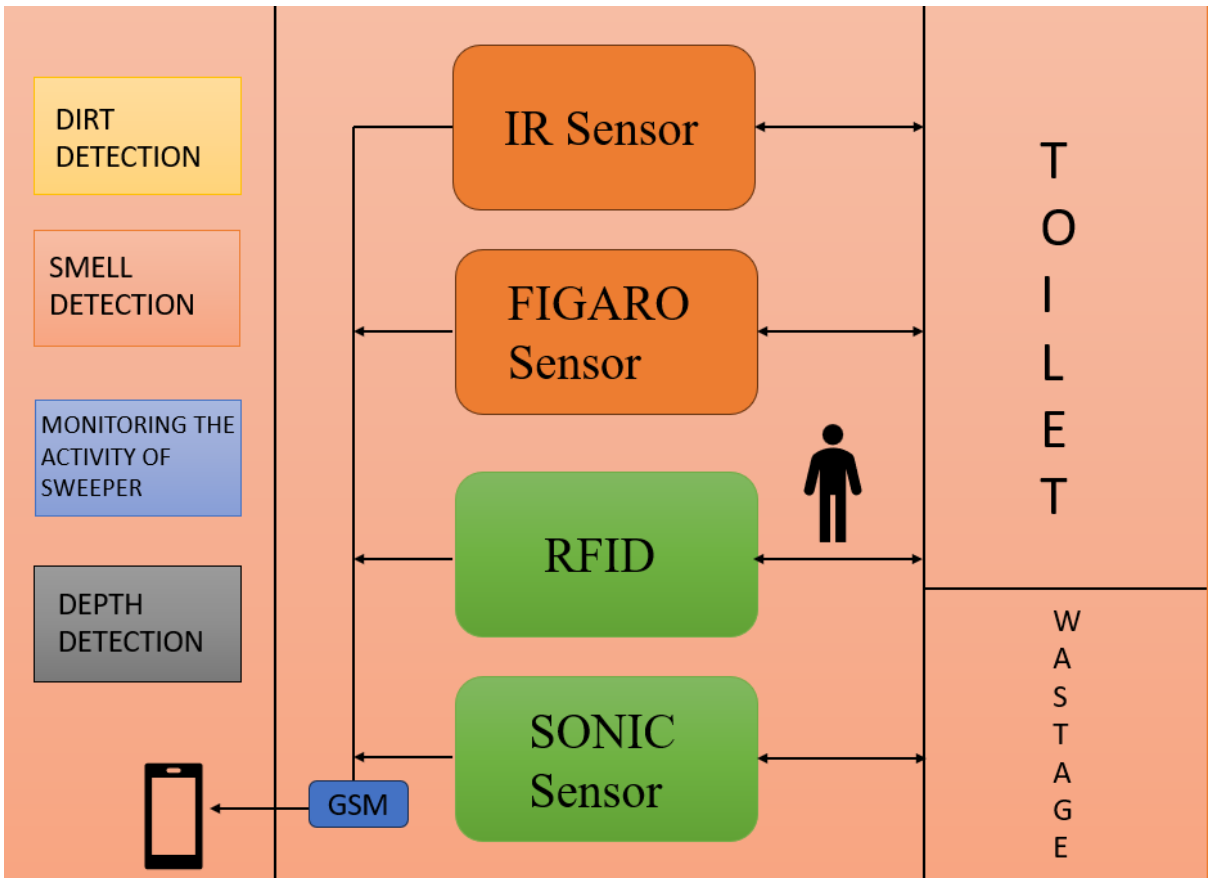
Ultrasonic Sensor

- **Function**: Measures distance.
- **Use Case**:
    - Monitors water levels in the toilet tank.
    - Detects a user's position to trigger automatic flushing or adjust seat height.

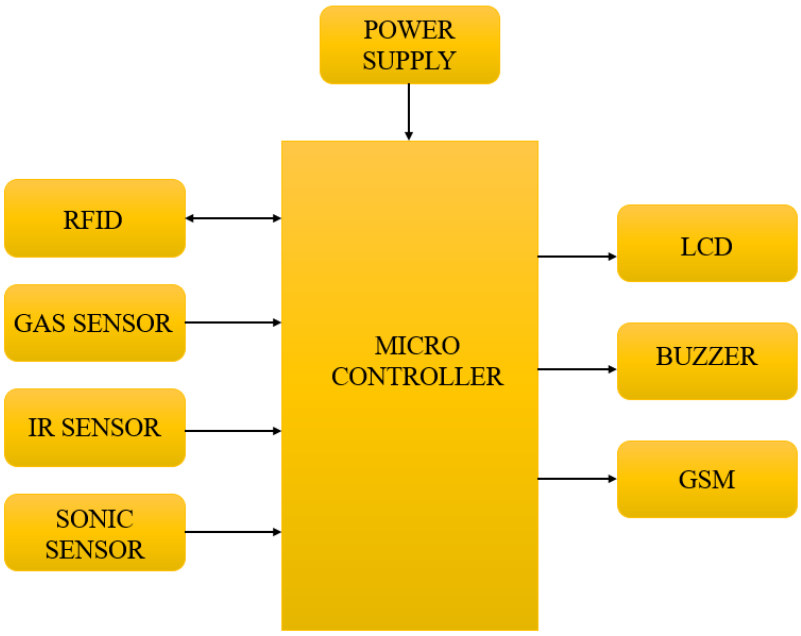
Figaro Sensor

- **Function**: Specialized sensor for detecting gases like methane or hydrogen.
- **Use Case**:
    - Works alongside the gas sensor to improve accuracy in identifying specific gases.

3.6 CIRCUIT DIAGRAM



BLOCK DIAGRAM



4. CONCLUSION AND FUTURE WORK:

4.1 Conclusion

The **Smart Toilet System for Old Age People Using IoT** is an innovative and practical solution tailored to the specific needs of the elderly. This system addresses hygiene, health monitoring, safety, and accessibility while promoting independence and improving quality of life. By integrating IoT technology with advanced sensor systems, the solution offers real-time health insights and emergency alert capabilities, reducing the burden on caregivers and healthcare systems.

The design emphasizes sustainability, using eco-friendly materials and energy-efficient components, aligning with global priorities like the **Sustainable Development Goals (SDGs)**. Community involvement and NGO partnerships are integral to its success, ensuring accessibility and widespread adoption. The proposed milestones and budget provide a structured framework for implementation, with scalability for broader impact.

This project exemplifies how technology can bridge gaps in eldercare, providing dignity and security to aging populations. The continued evolution of this system could redefine home healthcare and sanitation for vulnerable demographics worldwide.

4.2 Reference

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5. Elderly Care Technologies. (2022). *Smart Sanitation Systems*. Springer Publications.
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4.3 Future Development

The Smart Toilet System has the potential for further enhancements and expanded applications. Future development areas include:

4.3.1 Advanced Health Monitoring

- Integration of additional non-invasive sensors for broader health data collection, such as hydration levels, hormonal imbalances, or early signs of diseases like cancer.
- Incorporation of machine learning algorithms for predictive health analysis and personalized healthcare recommendations.

4.3.2 Enhanced Usability

- Development of multilingual voice-command systems for global usability.
- Gesture-controlled features for users with severe mobility impairments.

4.3.3 Expanded Connectivity

- Integration with wearable health devices for comprehensive health monitoring.
- Compatibility with smart home systems like Amazon Alexa or Google Home for seamless automation.

4.3.4 Data Privacy and Security

- Implementation of advanced encryption and blockchain technology to secure sensitive health data.
- Offering users complete control over data sharing, complying with global privacy standards like GDPR.

4.3.5 Sustainability and Cost Reduction

- Further research into biodegradable and recyclable materials for the system's components.
- Optimization of production processes to lower costs and make the system more affordable in developing countries.

4.3.6 Scalability for Broader Demographics

- Modifying the design to accommodate differently-abled individuals and children.
- Expanding deployment in public restrooms, hospitals, and eldercare facilities.

By addressing these future developments, the Smart Toilet System can evolve into a universally accessible, highly efficient, and globally impactful solution.