

PROFESSIONAL TRAINING REPORT - II

entitled

NIGHT PATROLLING ROBOT

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering with
specialization in Internet of Things

by

K. DEEPTHI [41732007]



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

CATEGORY -1 UNIVERSITY BY UGC

**Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY 2024



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Professional Training Report is the bonafide work of **Ms.K. DEEPTHI (41732007)** who carried out the project entitled "**NIGHT PATROLLING ROBOT**" under my supervision from January 2024 to May 2024.

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DECLARATION

I, K.Deepthi (41732007) hereby declare that the Professional Training Report-II entitled "NIGHT PATROLLING ROBOT" done by me under the guidance of Mrs. K. Abinaya M.E, (Ph.D), is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering with specialization in Internet of Things.

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SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

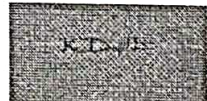
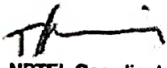
I convey my thanks to **Dr. T.Sasikala M.E., Ph.D., Dean, School of Computing, Dr. S.Vigneshwari M.E., Ph.D., Head of the Department of Computer Science and Engineering** for providing me necessary support during the progressive reviews.

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COURSE CERTIFICATE

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Candidate Name	DEEPTI KAMI REDDY					
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Exam Timing	02:00 pm	Shift	AN			
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Unit wise Progress

Unit	Lesson Progress	Assignments Progress
About NPTEL	100.0%	-
How does an NPTEL online course work?	100.0%	-
Week 0	100.0%	-
Week 1	100.0%	0.0%
Week 2	100.0%	0.0%
Week 3	100.0%	100.0%
Week 4	100.0%	100.0%

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Unit wise Progress

NOTE: The latest Course and Unit progress will be reflected within 24 hours.

Week 5	100.0%	100.0%
Week 6	100.0%	100.0%
Week 7	100.0%	100.0%
Week 8	100.0%	100.0%
Week 9	100.0%	100.0%
Week 10	100.0%	100.0%
Week 11	100.0%	100.0%
Week 12	100.0%	100.0%

ABSTRACT

Ensuring the safety of women, especially during nighttime, remains a critical concern in many communities. In response to this challenge, this abstract proposes the development of a night patrolling robot designed specifically to enhance women's safety in urban environments. The proposed robot integrates advanced technologies to autonomously patrol designated areas, detect potential threats, and provide timely assistance to individuals in need. Equipped with a range of sensors including cameras, infrared sensors, and motion detectors, the robot can effectively monitor its surroundings and identify suspicious activities. Furthermore, the robot is designed to communicate with both authorities and civilians, offering real-time assistance and emergency response capabilities. Through two-way communication channels and a user-friendly interface, individuals can easily interact with the robot to seek help or report incidents. Additionally, the robot's mobility, navigation, and mapping systems enable it to navigate diverse terrains and patrol predefined routes with efficiency. It is also equipped with remote control capabilities, allowing authorities to intervene and guide the robot's actions as needed. Privacy and security considerations are paramount in the design of this robot, ensuring that data collected is handled responsibly and sensitive information is protected. Traditional security measures such as police patrols or surveillance cameras may be insufficient or inaccessible in certain areas, leaving women vulnerable to potential threats. Moreover, the effectiveness of these measures can be compromised by factors such as resource constraints, response times, and biases within law enforcement systems. In conclusion, the development of a night patrolling robot for women's safety presents a promising solution to address the persistent challenges of urban safety. By leveraging advanced technologies and human-centric design principles, this robot aims to contribute to creating safer and more inclusive communities for all individuals.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	vi
	LIST OF FIGURES	vii
1	INTRODUCTION	1
	1.1 Overview	
2	LITERATURE SURVEY	6
	2.1 Survey	
3	REQUIREMENTS ANALYSIS	
	3.1 Objective	8
	3.2.1 Hardware Requirements	
	3.2.2 Software Requirements	10
4	DESIGN DESCRIPTION OF PROPOSED PRODUCT	12
	4.1.1 Ideation Map/Architecture Diagram	13
	4.1.2 Various stages	15
	4.1.3 Internal or Component design structure	15
	4.1.4 working principles	16
	4.2 4.2.1 Novelty of the Project	18
5	CONCLUSION	27
	REFERENCES	28
	APPENDIX	
	A. Research Paper	29
	B. Source Code	40

LIST OF FIGURES

Figure No.	Figure Name	Page No.
1	Structure of embedded systems	4
2	MQTT architecture diagram	5
3	Hardware architecture	13
4	Robotic architecture	14
5	Internal design structure	16
6	Complete hardware setup of the project	21
7	Top view of the robotic setup	22
8	Login page	23
9	Home page	24
10	Patrol robot initiation	25
11	Abnormal condition page of the mobile application	26

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

In urban environments, particularly during the night, ensuring the safety of women remains a pressing concern. Despite numerous efforts to address this issue, the persistent threat of harassment and violence continues to undermine the sense of security for many. In response to this challenge, the development of a night patrolling robot tailored specifically to enhance women's safety emerges as a promising solution.

This introduction sets the stage for exploring the innovative concept of a night patrolling robot designed to safeguard women in urban settings. By leveraging advanced technologies and human-centric design principles, this robot aims to revolutionize traditional approaches to security and surveillance. Through autonomous patrols, real-time threat detection, and responsive assistance, it seeks to create safer and more inclusive communities where women can move freely without fear or apprehension.

This introduction outlines the urgent need for such a solution, highlighting the persistent challenges faced by women in urban environments and emphasizing the potential of technology to address these concerns effectively. It sets the tone for further exploration into the design, functionality, and potential impact of the proposed night patrolling robot for women's safety.

It emphasizes the transformative potential of technology to catalyze meaningful progress towards creating safer, more equitable communities for all. By contextualizing the development of a night patrolling robot within these broader considerations, this introduction underscores the urgency and relevance of the proposed solution in addressing the complex challenges surrounding women's safety in urban spaces.

1.2 TECHNOLOGY USED

1.2.1 Robotics

Robotics is an interdisciplinary research area at the interface of computer science and engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe. Robotics draws on the achievement of information engineering, computer engineering, mechanical engineering, electronic engineering and others.

Robotics develops machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for many purposes, but today many are used in dangerous environments (including inspection of radioactive materials, bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, underwater, in high heat, and clean up and containment of hazardous materials and radiation).

Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

1.2.2 Embedded systems

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations.

Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user

interfaces. The complexity of an embedded system varies significantly depending on the task for which it is designed.

Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

Embedded systems are managed by microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), GPU technology, and gate arrays. These processing systems are integrated with components dedicated to handling electric and/or mechanical interfacing.

1.2.2.1 Structure of embedded systems

The basic structure of an embedded system includes the following components:

Sensor: The sensor measures and converts the physical quantity to an electrical signal, which can then be read by an embedded systems engineer or any electronic instrument. A sensor stores the measured quantity to the memory.

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

Processor & ASICs: Processors assess the data to measure the output and store it to the memory.

D-A Converter: A digital-to-analog converter changes the digital data fed by the processor to analog data

Actuator: An actuator compares the output given by the D-A Converter to the actual output stored and stores the approved output.

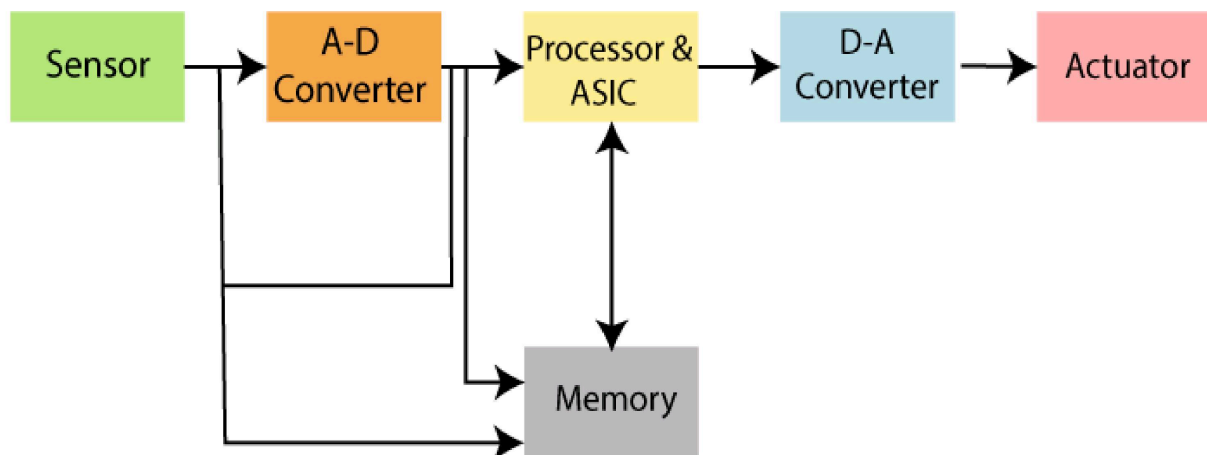


Fig 1.1 : Structure of embedded systems

1.2.3 MQTT

MQTT(MQ Telemetry Transport or Message Queuing Telemetry Transport) is an open OASIS and ISO standard lightweight, publish-subscribe network protocol that transports messages between devices. The protocol usually runs over TCP/IP; however, any network protocol that provides ordered, lossless, bi-directional connections can support MQTT. It is designed for connections with remote locations where a "small code footprint" is required or the network bandwidth is limited.

The MQTT protocol defines two types of network entities: a message broker and a number of clients. An MQTT broker is a server that receives all messages from the clients and then routes the messages to the appropriate destination clients. An MQTT client is any device (from a micro controller up to a full-fledged server) that runs an MQTT library and connects to an MQTT broker over a network.

Information is organized in a hierarchy of topics. When a publisher has a new item of data to distribute, it sends a control message with the data to the connected broker. The broker then distributes the information to any clients that have subscribed to that topic.

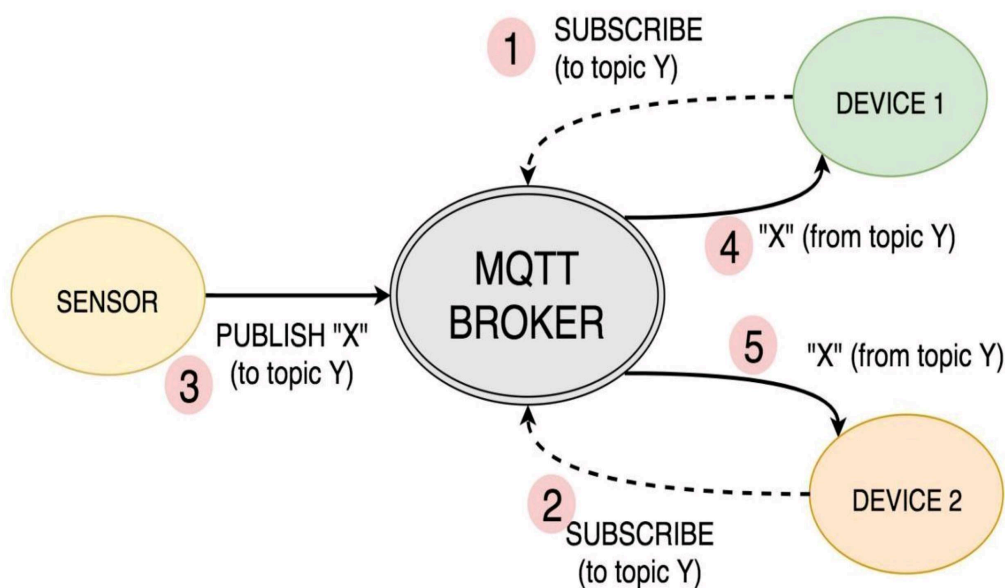


Fig: 1.2 MQTT architecture diagram

When a publishing client first connects to the broker, it can set up a default message to be sent to subscribers if the broker detects that the publishing client has unexpectedly disconnected from the broker. Clients only interact with a broker, but a system may contain several broker servers that exchange data based on their current subscribers' topics. A minimal MQTT control message can be as little as two bytes of data. A control message can carry nearly 256 megabytes of data if needed.

There are fourteen defined message types used to connect and disconnect a client from a broker, to publish data, to acknowledge receipt of data, and to supervise the connection between client and server. MQTT relies on the TCP protocol for data transmission.

CHAPTER 2

LITERATURE REVIEW

2.1 Survey

This article proposes a standalone radio frequency identification (RFID)-based mobile robot navigation method, in which a mobile robot equipped with reader antennas can be continuously guided to a static object marked with a single passive UHFRFID tag. An observation model based on the RFID phase difference is built and integrated into a particle filter, by which the instantaneous relative position between the mobile robot and the tagged object can be detected in real time. Based on the position information extracted from the RFID system, the mobile robot adjusts its pose to move toward the RFID-tagged object. Compared with the existing RFID-based mobile robot navigation methods, the proposed method requires no external sensors other than the RFID and requires only a single passive tag. Experiments using commercial off-the-shelf (COTS) RFID devices are performed, and the results indicate that the mobile robot can satisfactorily realize navigation task with a distance accuracy of 4.04 cm and a bearing accuracy of 2.23°. The proposed method is well applicable for the navigation scenes in which the absolute position of the tagged target object is not known beforehand.

The deployment of multiple robots for achieving a common goal helps to improve the performance, efficiency, and/or robustness in a variety of tasks. In particular, the observation of moving targets is an important multirobot application that still exhibits numerous open challenges, including the effective coordination of the robots. This paper reviews control techniques for cooperative mobile robots monitoring multiple targets. The simultaneous movement of robots and targets makes this problem particularly interesting, and our review systematically addresses this cooperative multirobot problem for the first time. We classify and critically discuss the control techniques: cooperative multirobot observation of multiple moving targets, cooperative search, acquisition, and track, cooperative tracking, and multirobot pursuit evasion. We also identify the five major elements that characterize this problem, namely, the coordination method, the environment, the target, the robot and its sensor(s). These elements are used to systematically analyze the control techniques. The majority of the

studied work is based on simulation and laboratory studies, which may not accurately reflect real-world operational conditions. Importantly, while our systematic analysis is focused on multitarget observation, our proposed classification is useful also for related multirobot applications.

CHAPTER 3

REQUIREMENTS ANALYSIS

3.1 OBJECTIVE OF THE PROJECT

The primary objective of the night patrolling robot project is to enhance the safety and security of women in urban environments during nighttime. To achieve this overarching goal, the project aims to accomplish the following specific objectives:

Preventive Patrols: Implementing a system of autonomous patrols whereby the robot systematically monitors designated areas, deter potential threats, and create a visible presence to discourage criminal activities.

Real-Time Threat Detection: Equipping the robot with advanced sensor technologies, including cameras, infrared sensors, and motion detectors, to detect and identify suspicious activities or individuals in its vicinity.

Responsive Assistance: Providing immediate assistance and support to individuals in distress by establishing two-way communication channels between the robot and both authorities and civilians. This includes guiding individuals to safety, alerting emergency services, and facilitating communication with nearby law enforcement agencies.

Community Engagement and Education: Engaging with local communities to raise awareness about women's safety issues, promote proactive safety measures, and foster trust and collaboration between residents and the night patrolling robot.

Data Collection and Analysis: Collecting and analyzing data on patrol routes, incident reports, and environmental conditions to identify patterns, trends, and areas of concern. This information can inform targeted interventions, resource allocation, and policy recommendations to further enhance women's safety.

Continuous Improvement and Innovation: Iteratively refining the robot's design, functionality, and operational protocols based on feedback from stakeholders, technological advancements, and evolving safety needs. This includes incorporating machine learning algorithms to improve threat detection capabilities, optimizing navigation algorithms for efficient patrol routes, and integrating new features to address emerging challenges.

Integration with Existing Infrastructure: Ensuring seamless integration of the night patrolling robot with existing security infrastructure, emergency response systems, and community initiatives to maximize effectiveness and sustainability.

By fulfilling these objectives, the night patrolling robot project aims to contribute to the creation of safer, more inclusive urban environments where women can confidently and securely navigate public spaces at night.

The objective of implementing a night patrolling robot for women's safety is multifaceted, addressing various critical aspects of urban security. Firstly, the robot's primary mission revolves around preventive patrols, strategically navigating urban landscapes to deter potential threats and criminal activities against women. Equipped with sophisticated sensor arrays including cameras, infrared sensors, and motion detectors, the robot operates as a vigilant guardian, continuously scanning its surroundings for signs of danger. Moreover, its real-time threat detection capabilities enable swift identification of suspicious behavior or distress signals, triggering immediate response mechanisms.

3.2 REQUIREMENTS

The requirements for a night patrolling robot aimed at enhancing women's safety in urban environments encompass various technological, operational, and user-centric aspects:

- 1) Autonomous Navigation
- 2) Real-Time Surveillance
- 3) Threat Detection Algorithms
- 4) Two-Way Communication
- 5) Emergency Response Integration
- 6) User-Friendly Interface
- 7) Durability and Weather Resistance
- 8) Long Battery Life
- 9) Data Security and Privacy
- 10) Remote Monitoring and Control
- 11) Community Engagement Features
- 12) Scalability and Adaptability

3.2.1 HARDWARE REQUIREMENTS

- Raspberry Pi 3
- Ultrasonic Sensor
- DC Motor
- Robotic Chassis
- Resistors, capacitors and transistors
- Cables and Connectors
- LED and Diodes
- PCB and Breadboards
- Transformer
- Push Buttons
- Switch
- IC and IC socket

3.2.2 SOFTWARE REQUIREMENTS

- Linux-based operating systems such as Ubuntu or ROS (Robot Operating System)
- ROS (Robot Operating System)
- Navigation and Mapping Software:
- SLAM (Simultaneous Localization and Mapping) libraries
- Navigation stack
- OpenCV (Open Source Computer Vision) Library
- Python or C
- ROS Communication (ROS Comms)
- MQTT (Message Queuing Telemetry Transport)
- IOT Gecko

CHAPTER 4

DESIGN DESCRIPTION OF PROPOSED PROJECT

4.1 PROPOSED METHODOLOGY

Robberies, burglaries and thefts continue to plague the length and breadth of this country. As per the National Crime Records Bureau (NCRB), 2,44,119 cases of robbery, theft, burglary, dacoity, among others, took place in residential premises in 2017. This was a jump of over 10% from 2016 when the number of such cases stood at 2,20,854. The financial loss due to these thefts and burglaries are staggering. In 2017, value of property stolen from residential premises was in excess of Rs. 2065 crores, a 40% jump from Rs. 1,475 crores stolen the previous year. Indeed, home safety is a serious concern for the residents as well as the police and the authorities.

To overcome this problem we have developed a project that gives a technological solution using a robot. In this project we develop a robot with a hardware module connected with a camera and sound sensors embedded to it. A mobile application is developed using react native. The robot is given a specified distance to patrol around repeatedly, in case an abnormal noise is detected by the sound sensor the robot immediately alerts the nearby police personnel with an alert and also provides a live streaming through the mobile application.

ADVANTAGES :

- Reliable and effective solution for patrolling during the night.
- Reduces the manpower required for night patrolling.
- Effectively reduces crime
- A mobile application is developed to alert and provide the live streaming to police personal.

4.1.1 Ideation Map/System Architecture

The system architecture of a night patrolling robot encompasses the various software and hardware components that work together to enable the robot to perform its designated tasks efficiently.

This describes the overall and the detailed architectural design. The architectural diagram is shown in Figure 4.1

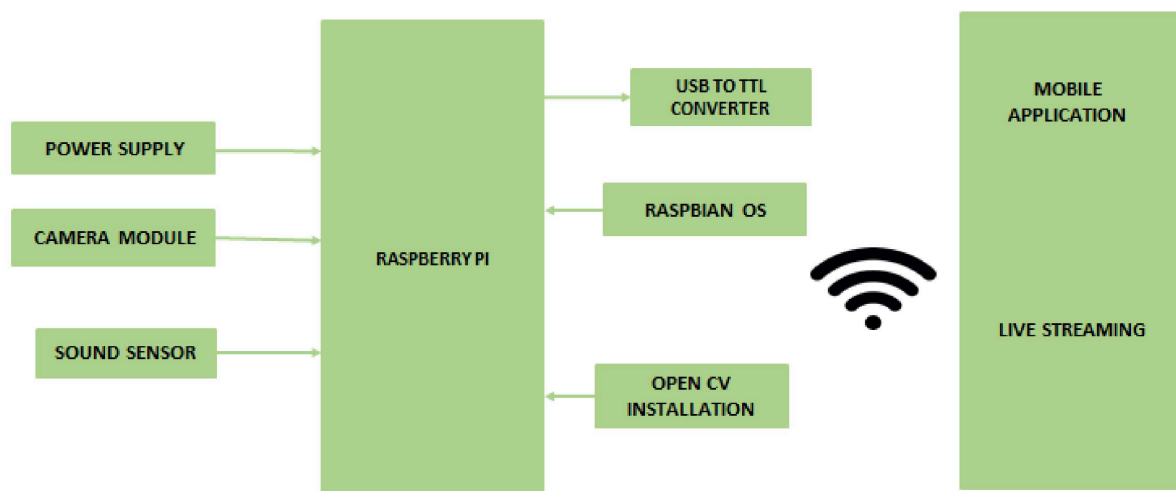


Fig 4.1 Hardware architecture

The architecture of a night patrolling robot outlines the organization and interaction of its various hardware and software components, ensuring efficient operation.

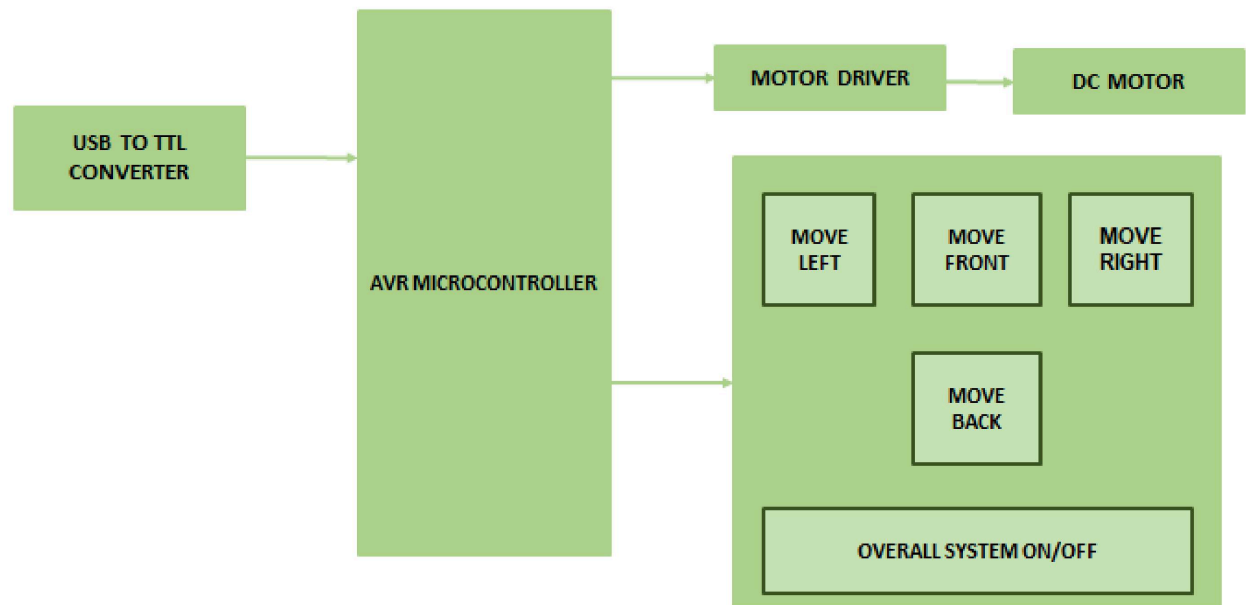


Fig 4.2 Robotic architecture

4.1.2 Various Stages

The night patrolling robot undergoes several stages throughout its operation, from initial deployment to routine patrols and maintenance. Here are the various stages:

- Planning and Design
- Development and Assembly
- Deployment and Calibration
- Training and Familiarization
- Routine Patrols
- Monitoring and Maintenance
- Evaluation and Optimization

4.1.3 *Internal or Component design structure*

The internal design structure of a night patrolling robot comprises the organization and interconnection of various hardware and software components.

By meticulously designing and integrating these internal components, the night patrolling robot can operate autonomously, navigate challenging environments, and fulfill its role in enhancing safety and security during nighttime patrols.

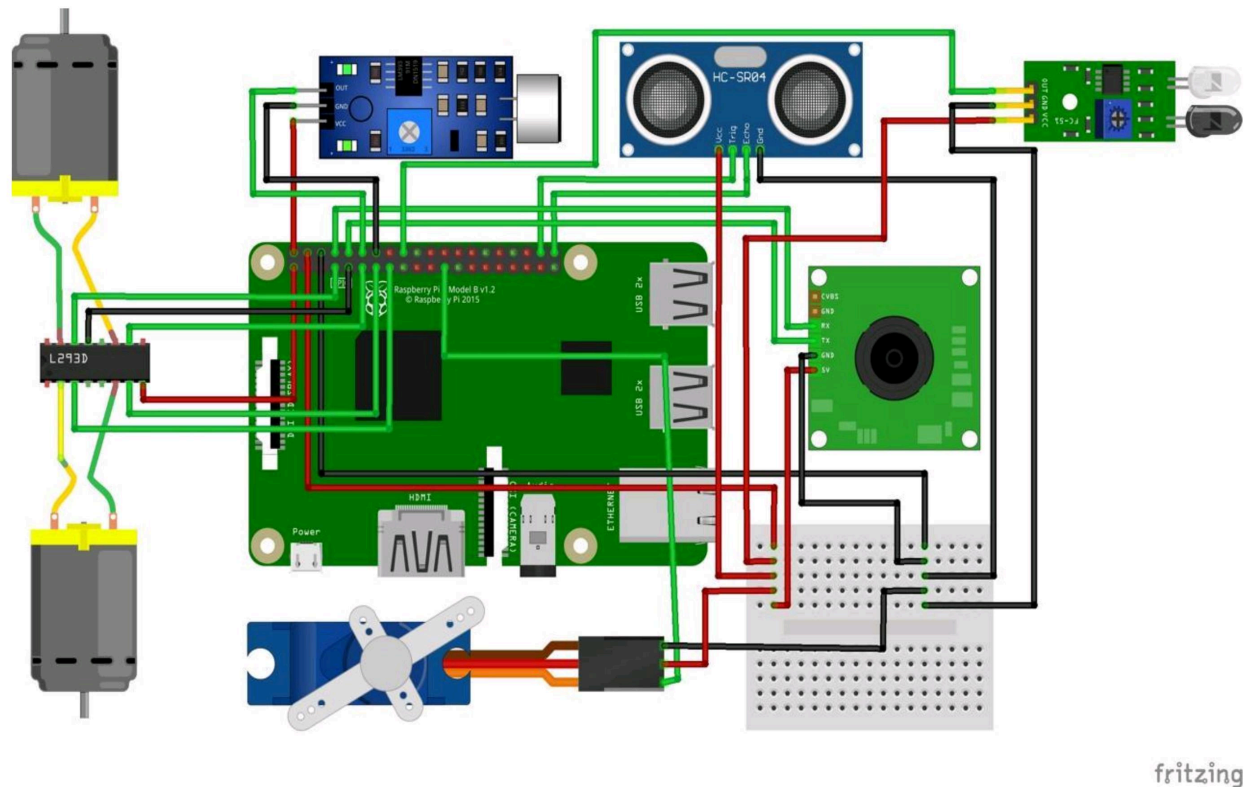


Fig 4.3 Internal design structure

4.1.4 working principles

The working principles of a night patrolling robot involve a combination of hardware and software systems that enable it to autonomously navigate, monitor its environment, and respond to potential threats or incidents. Here's an overview of the key working principles:

Autonomous Navigation:

- The robot utilizes sensors such as cameras, LiDAR, and infrared sensors to perceive its surroundings and create a map of the environment.
- Using simultaneous localization and mapping (SLAM) algorithms, the robot determines its position relative to landmarks and obstacles in real-time.
- Path planning algorithms compute optimal routes based on the map and predefined goals, avoiding obstacles and optimizing for efficiency.

Surveillance and Detection:

- The robot continuously monitors its surroundings using onboard cameras, infrared

sensors, and other detection mechanisms.

- Image processing algorithms analyze camera feeds to detect objects, identify individuals, and recognize patterns of behavior.
- Infrared sensors provide night vision capabilities, enabling the robot to detect heat signatures and movement in low-light conditions.

Threat Detection and Recognition:

- Advanced algorithms analyze sensor data to detect potential threats or suspicious activities, such as loitering, unauthorized entry, or aggressive behavior.
- Machine learning and artificial intelligence techniques may be employed to recognize specific threat patterns or anomalies in the environment.

Communication and Interaction:

- The robot features two-way communication capabilities, allowing it to interact with individuals in its vicinity and communicate with remote operators or control centers.
- Individuals can initiate communication with the robot through voice commands, touchscreens, or panic buttons, requesting assistance or reporting incidents.

Response and Intervention:

- Upon detecting a potential threat or receiving a distress signal, the robot assesses the situation and determines an appropriate response.
- Depending on the severity of the situation, the robot may provide verbal instructions, guide individuals to safety, or alert nearby authorities or emergency services.
- It may also record and transmit video footage or sensor data to aid in incident analysis and response coordination.

Continuous Monitoring and Adaptation:

- The robot operates continuously, patrolling designated areas according to predefined schedules or dynamically adjusting its route based on real-time data and feedback.
- It continuously monitors its own status, sensor readings, and environmental conditions, performing self-diagnosis and self-calibration as needed.
- Machine learning algorithms enable the robot to adapt and learn from its experiences, improving its performance over time and enhancing its ability to recognize and respond to evolving threats.

By leveraging these working principles, the night patrolling robot operates effectively as a proactive security solution, enhancing safety and security in urban environments, particularly during night time patrols.

4.2 FEATURES

The features of a night patrolling robot are designed to enhance safety and security in urban environments, particularly during nighttime patrols. Here are some key features commonly found in such robots:

Autonomous Navigation: The ability to navigate autonomously using sensors and mapping algorithms, allowing the robot to patrol designated areas without human intervention.

Real-Time Surveillance: Onboard cameras and sensors provide real-time monitoring of the robot's surroundings, enabling it to detect and respond to potential threats or incidents.

Night Vision: Infrared sensors and low-light cameras enable the robot to operate effectively in darkness or low-light conditions, providing enhanced surveillance capabilities during nighttime patrols.

Threat Detection: Advanced algorithms analyze sensor data to detect suspicious activities or behaviors, such as loitering, unauthorized entry, or aggressive gestures.

Two-Way Communication: The robot features two-way communication capabilities, allowing individuals to interact with it and request assistance in case of emergencies.

Emergency Response: Upon detecting a potential threat or receiving a distress signal, the robot can provide assistance, guidance, or alert nearby authorities or emergency services.

Patrol Scheduling and Routing: The ability to schedule and optimize patrol routes based on safety priorities, population density, and historical crime data, ensuring efficient coverage of designated areas.

Remote Monitoring and Control: Operators can remotely monitor the robot's status, sensor data, and video feeds in real-time, enabling proactive intervention or response coordination.

Environmental Sensors: Additional sensors, such as temperature, humidity, or air quality sensors, provide environmental monitoring capabilities, detecting changes or hazards in the robot's surroundings.

Robust Construction: Durable and weather-resistant construction ensures the robot can withstand outdoor conditions, including rain, dust, and extreme temperatures.

Scalability and Integration: The robot's architecture allows for scalability and integration with existing security infrastructure, emergency response systems, and community initiatives.

Data Logging and Analysis: The ability to log and analyze patrol data, incident reports, and environmental conditions, providing insights for optimization, resource allocation, and policy recommendations.

User-Friendly Interface: Intuitive user interfaces, including graphical displays and voice commands, enable easy interaction with the robot for operators, residents, and emergency responders.

Community Engagement: Features such as informational displays, community messaging, or interactive elements encourage public participation and collaboration in safety initiatives.

Continuous Improvement: The robot incorporates mechanisms for continuous improvement, including software updates, feedback mechanisms, and machine learning algorithms to adapt and evolve over time.

These features collectively enable the night patrolling robot to proactively enhance safety and security in urban environments.

4.2.1 Novelty of the proposal

The proposal for a night patrolling robot introduces a novel approach to enhancing safety and security in urban environments, particularly during nighttime. By leveraging advanced autonomous technologies and real-time surveillance capabilities, the proposal aims to address the unique challenges associated with nocturnal patrols. One key novelty lies in the integration of night vision capabilities, including infrared sensors and low-light cameras, enabling the robot to operate effectively in darkness or low-light conditions where traditional security measures may be limited.

Additionally, the proposal emphasizes a data-driven approach to safety, collecting and analyzing data on patrol routes, incidents, and environmental conditions to inform targeted interventions and policy recommendations. Furthermore, the proposal advocates for community engagement and collaboration, involving local residents, law enforcement agencies, and community organizations in the deployment and operation of the night patrolling robot.

This collaborative approach fosters a sense of ownership and partnership in addressing safety concerns, enhancing the overall effectiveness and sustainability of the initiative. Overall, the proposal represents a novel and innovative solution to improving safety and security in urban areas, with potential for significant positive impact on public safety and well-being for all individuals and others.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Final outputs obtained :

The below image shows the complete patrol robotic setup of the project:

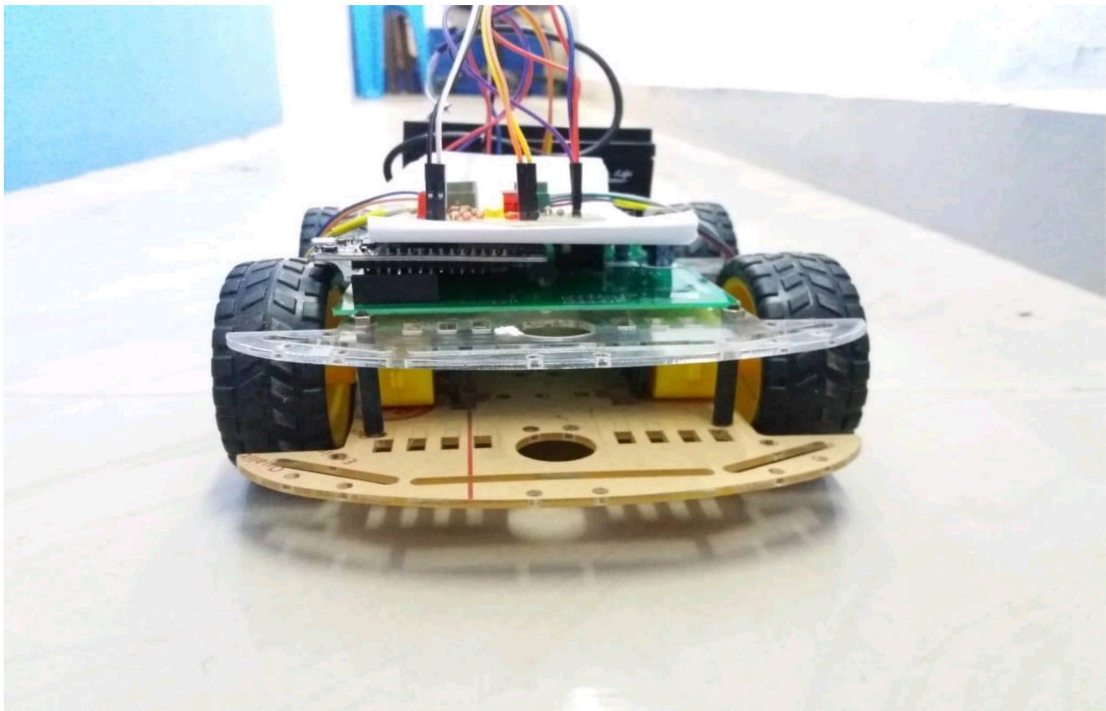


Fig 5.1 Complete hardware setup of the project

The below image shows the top view of the robotic setup:

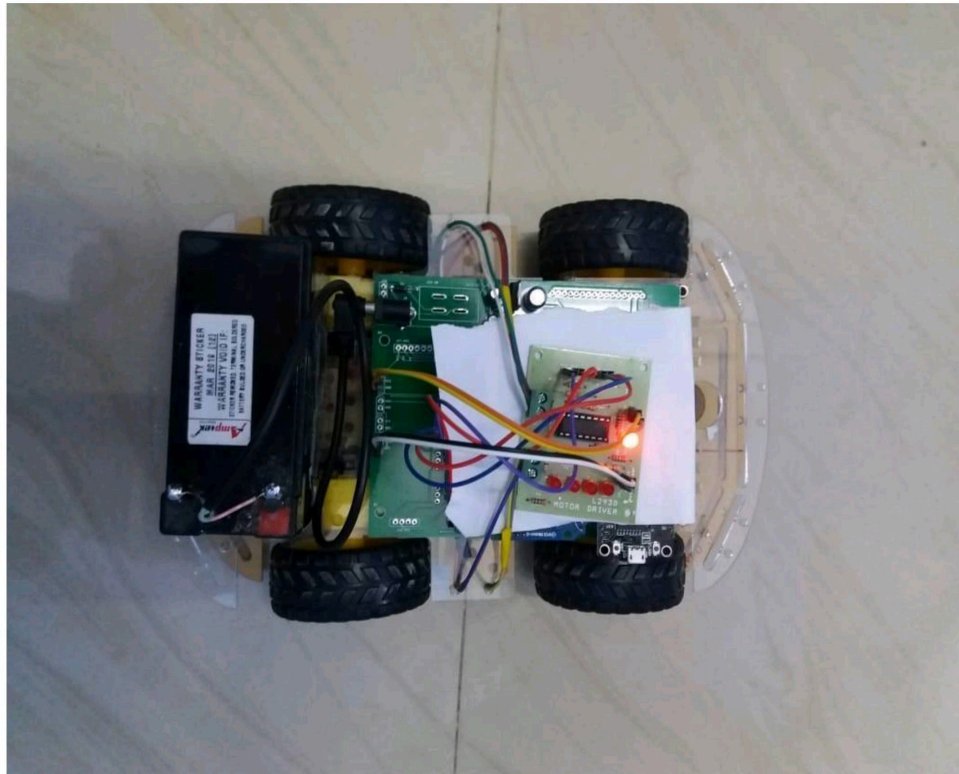


Fig 5.2 Top view of the robotic setup

A mobile application using a javascript framework react native is developed.The belowimage shows the login page of the mobile application:

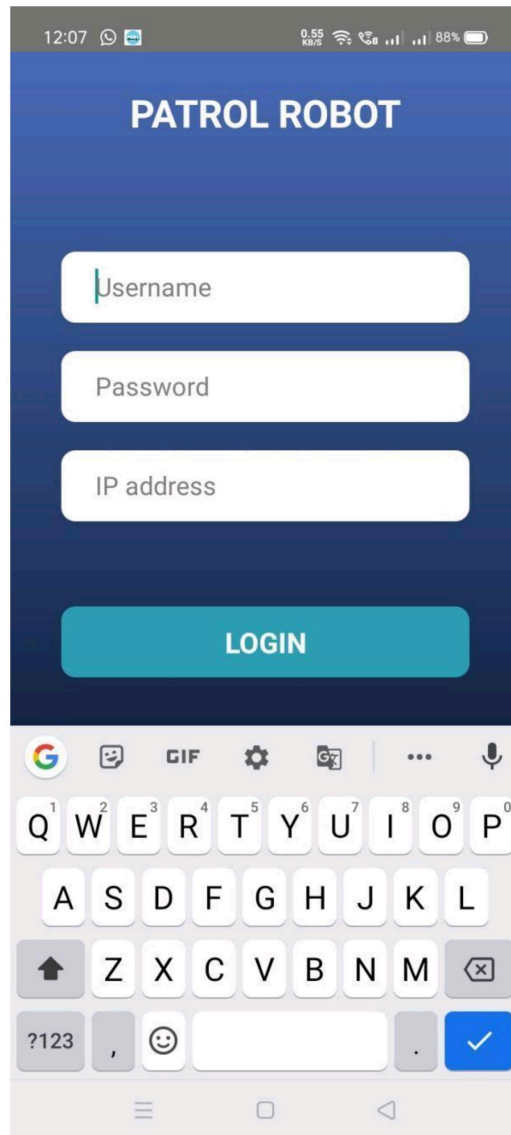


Fig 5.3 Login page

The below image shows the login page of the mobile application on successful login:



Fig 5.4 Home page

The below image shows the initiation of the robotic setup:

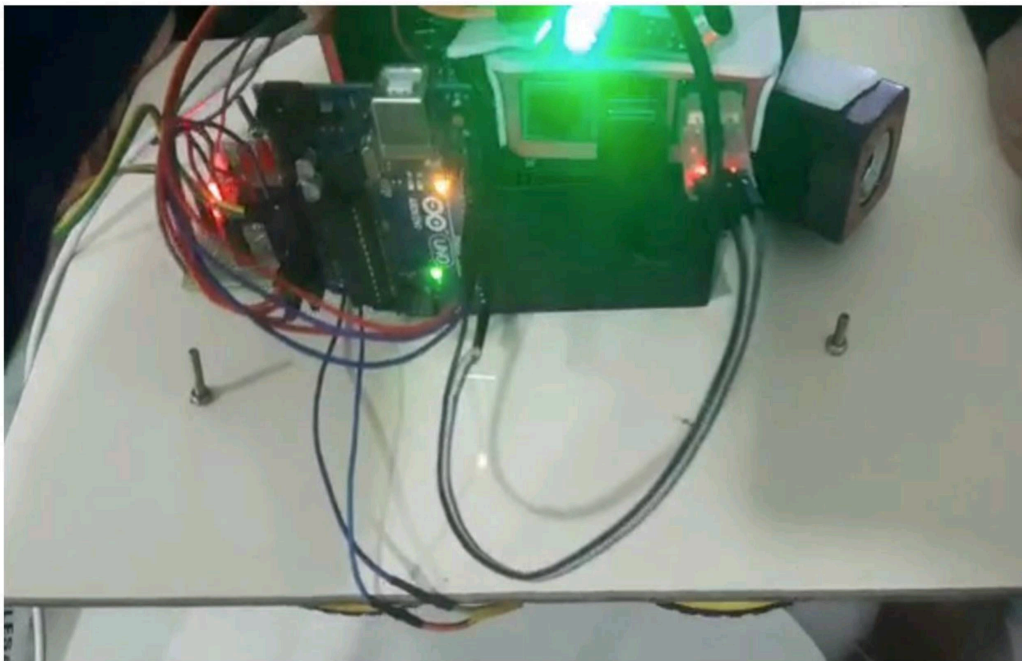


Fig 5.5 Patrol robot initiation

The below image shows the page of the mobile application on hearing an abnormal voice by the patrol robot with live streaming initiated and also a notification is sent through the mobile application:

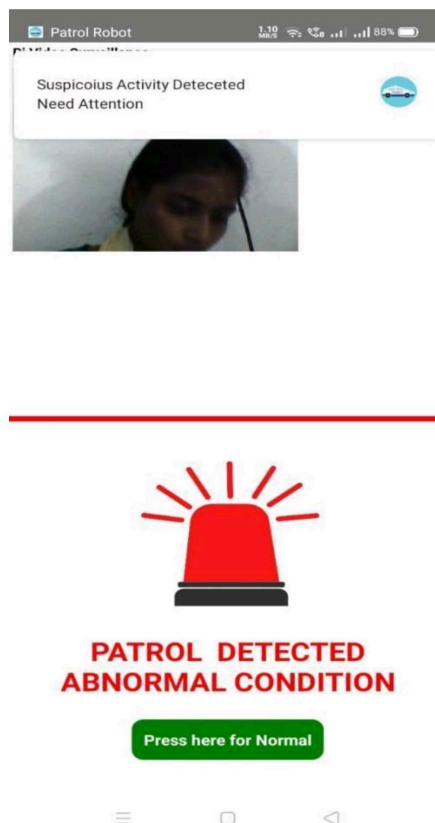


Fig 5.6 Abnormal condition page of the mobile application

CHAPTER 6

CONCLUSION

In conclusion, The implementation of a night patrolling robot represents a promising and innovative approach to enhancing safety and security in urban environments, particularly during nighttime. Through its autonomous navigation capabilities, advanced surveillance technologies, and real-time threat detection algorithms, the night patrolling robot offers a proactive solution to address safety concerns and mitigate potential risks. By leveraging night vision capabilities, the robot can effectively operate in low-light conditions, providing continuous monitoring and surveillance where traditional security measures may be limited.

Furthermore, the proposal emphasizes the importance of community engagement and collaboration, involving local residents, law enforcement agencies, and community organizations in the deployment and operation of the robot. This collaborative approach fosters a sense of shared responsibility and ownership in addressing safety challenges, ultimately contributing to safer and more inclusive communities. Overall, the implementation of a night patrolling robot holds significant promise for improving public safety, enhancing security infrastructure, and fostering a greater sense of security and well-being in urban environments.

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Steerability of Robots Moving on Sloping Terrains”

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[6] Guillaume Doisy; Joachim Meyer; Yael Edan,” The Impact of Human–Robot Interface Design on the Use of a Learning Robot System ”

[7] Feng Gu; Yuqing He; Jianda Han,” Active Persistent Localization of a Three-Dimensional Moving Target Under Set-Membership Uncertainty Description Through Cooperation of Multiple Mobile Robots”

[8] C. Serkan Karagöz; H. Işıl Bozma; Daniel E. Koditschek,” Coordinated Navigation of Multiple Independent Disk-Shaped Robots”

[9] Guanglong Du; Mingxuan Chen; Caibing Liu; Bo Zhang; Ping Zhang,” Online Robot Teaching With Natural Human–Robot Interaction”

[10] P.H.L. Silva; A.M.F. Burlamaqui,” System for Creation, Programming and Availability of Distributed Robot Teams using Collective Knowledge ”

APPENDIX

A. RESEARCH PAPER

MACHINE LEARNING AND IT'S USE IN HEALTHCARE DIAGNOSTICS

Sathyabama Institute of Science and Technology In Association with

Inti International University, Malaysia Organizing

International Conference on Innovative techniques in Artificial Intelligence and Communication Technologies (ICITAICT 2K24)

Research Type (Original Article)

MACHINE LEARNING AND IT'S USE IN HEALTHCARE DIAGNOSTICS

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Abstract

Machine learning has emerged as a life-changing technology with keen implications for healthcare diagnostics. Use of ML in healthcare, we depend on proceeding each always-changing enduring statistics set. We are able to routine such facts near discovery forms that let health practitioners to recognize original ailments, type conclusions nearby perils, then guess handling upshots.

Moreover, we assess the integration of ML with different types of healthcare data, such as electronic health records(EHR), medical imaging, genomic data, and wearable sensor data, pointing up the distinctive challenges and opportunities related with each methods in the data. In addition, we consider the ethical and regulatory considerations that go together with the implementation of ML in healthcare diagnostics, including concerns related to data confidentiality, algorithmic bias, and transparency.

Through analysis of recent case studies, we exemplify the diverse range of diseases and circumstances that ML has been applied to for diagnostic purposes, including but not restricted to cancer, cardiovascular disease, neurodegenerative diseases, and contagious diseases. Also we can deliberate about the potential impact of ML on upgrading diagnostic accuracy, diminishing healthcare costs, and emphasizing the patient outcomes.

Keywords

ML - Machine learning , EHR - Electronic Health Records

1. INTRODUCTION

In current centuries, ML has emerged by way of an important device with the potential to transform various industries, including healthcare. One of the most optimistic applications of ML in healthcare is in diagnostics, where it has the potential to amplify accuracy, productivity, and approachability of disease recognition and diagnosis.

Traditional and classical diagnostic approaches often depend on instinctive interpretations or predetermined rules, which can be inclined to errors and may not fully make use of the wealth of obtainable data. ML, on the other hand, provides the ability to draw out complicated patterns and perceptions from huge datasets, facilitating more accurate and individualize diagnostic results.

This introduction aims to provide survey of the present landscape of ML in healthcare diagnostics, pointing up its potential advantages, challenges, and foresights. We will explore the distinct types of ML algorithms used in healthcare settings, the combination of ML with various healthcare data modalities, and the social and regulatory considerations that co-occur with its adoption. In addition, we will discuss the consequences of ML on enhancing diagnostic validity, reducing healthcare charges, and improving patient outcomes.

1.1 POST OCCUPANCY EVALUATION (POE)

By conducting a comprehensive post-occupancy evaluation of ML-based diagnostic systems in

healthcare, stakeholders can acquire valuable insights into their real-world performance, impact, and usability, ultimately leading to improvements in patient care and outcomes.

Collect data on the usage of the ML-based diagnostic system in healthcare settings. This could include the number of cases diagnosed using the system, the types of diseases or conditions diagnosed, patient outcomes, and any report from healthcare professionals who utilized the system. Assess the correctness and performance of the ML system in real-life scenarios compared to its performance while development and testing phases.

This evaluation could include comparing the system's diagnostic accuracy, sensitivity, specificity, and predictive values with established benchmarks or alternative diagnostic methods. Evaluate the clinical effect of the ML-based diagnostic system on patient care and results. This could involve evaluating whether the system led to earlier identification of diseases, more accurate diagnoses, changes in treatment plans, or improvements in patient outcomes such as decreased mortality or morbidity rates.

Collect reviews from healthcare professionals who used the ML system in their clinical practice. Assess features such as user interface design, ease of use, integration into existing workflows, perceived usefulness, and overall contentment with the system. Contemplate the ethical and societal suggestions of deploying ML-based diagnostic systems in healthcare settings. Assess affairs such as patient privacy, data security, algorithmic bias, and the potential influence on healthcare inconsistencies.

Conduct a cost-effectiveness analysis to decide whether the advantages of applying the ML-based diagnostic system outweigh the costs correlated with its development, deployment, and maintenance. Establish mechanisms for under way monitoring and refinement of the ML system post-deployment. This could include consistent updates to the system based on new data and feedback, as well as constant training of healthcare professionals to guarantee perfect use of the system.

1.1.1 FINDINGS AND DISCUSSION

Machine learning in healthcare is a immediately increasing field accompanying many uses, containing affliction disease, embodied situation plans, healing depict reasoning, and patient effect prognosis. To find appropriate facts and undertake conversations:

1. Research Journals and Publications: Explore distinguished journals to a degree "Journal of

Healthcare Informatics Research," "IEEE Journal of Biomedical and Health Informatics," and "Journal of Medical Internet Research" for current studies and progresses in machine intelligence in healthcare.

2. Online Forums and Communities: Join connected to the internet planks like Reddit's r/MachineLearning and r/healthIT, or specific forums like KDnuggets and Healthcare AI Community, place specialists and devotees review miscellaneous affairs had connection with machine intelligence in healthcare.
3. Conferences and Workshops: Attend conventions and studios directed on healthcare sciences concerned with information and machine intelligence, in the way that the Healthcare Information and Management Systems Society (HIMSS) colloquium and mills organized apiece International Conference on Machine Learning (ICML) and the Conference on Neural Information Processing Systems (NeurIPS).
4. Academic Courses and Webinars: Look for academic courses on policies like Coursera, edX, and Udacity that cover machine intelligence in healthcare. Additionally, accompany webinars accommodated by academies, research organizations, and manufacturing directors to stay amended on new incidents and flows.

LinkedIn Groups and Networking: Join LinkedIn groups had connection with healthcare sciences concerned with information, machine intelligence, and machine intelligence in healthcare. Engage accompanying pros engaged, share observations, and take part in arguments to supplement your information and network. When explaining machine intelligence in healthcare, grant moral associations, dossier solitude concerns, supervisory challenges, and the potential affect patient care. Additionally, stay cognizant about current case studies, breakthroughs, and challenges front the maintenance of machine intelligence sciences in healthcare backgrounds

1.1.1.1OBSERVATIONS

ACKNOWLEDGEMENTS

We would like to convey our profound gratitude to all individuals and organizations whose involvement have made this research feasible.

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Conclusion

Whereas nearby are numerous confines to overawed earlier instigating ML algorithms in scientific repetition, inclusive, they have revealed capable outcomes. SVM then advancing procedures remain regularly castoff hip cardiac linctus and have proved virtuous results. Though, picking appropriate processes aimed at explicit learning enquiries, linking them towards humanoid doyens, using endorsement allies, besides writing identical probable valuation metrics remain vital aimed at rendition studies hip exact quantifiable framework. Utmost notably, potential lessons associating ML progressions towards unadventurous hazard replicas remain obligatory. After authenticated in this way, ML algorithms might stay united per electric vigor best schemes then pragmatic hip medical rehearsal, principally hip resource-rich ranges.

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GUIDELINES FOR TABLES AND FIGURES

TABLES

First author	Analytic model	Sample	Indication	Imaging	Comparison	Database
Cardiac arrhythmias						
Alickovic et al. (2016)	RF	47	Arrhythmia detection	ECG	Five ECG signal patterns from MIT-BIH (normal (N), Premature Ventricular Complex (PVC), Atrial Premature Contraction (APC), Right Bundle Branch Block (RBBB) and Left Bundle Branch Block (LBBB)) and four ECG patterns from St. Petersburg Institute of Cardiological Technics 12lead Arrhythmia Database (N, APC, PVC and RBBB)	St. Petersburg and MIT-BIH database
Au-Yeung et al. (2018)	5sRF, 10sRF, SVM	788	Ventricular arrhythmia	ICD Data		SCD-HeFT study
Hill et al. (2018)	Logistic-linear regression, SVM, RF	2,994,837	Development of AF/flutter in gen pop	Clinical data	ML compared with conventional linear statistical methods	UK Clinical Practice Research Datalink (CPRD) between 01-01-2006 and 31-12-2016 was undertaken
Kotu et al. (2015)	k-NN, SVM, RF	54	arrhythmic risk stratification of post MI patients	Cardiac MRI	Low LVEF and Scar versus textural features of scar	Single center
Ming-Zhen Poh et al. (2018)	CNN	149,048	AF	ECG		Several publicly accessible PPG repositories, including the MIMIC-III critical care database, 11 the Vortal data set from healthy volunteers 12 and the IEEE-TBME PPG Respiratory Rate Benchmark data set. 1
Xiaoyan Xu et al. (2018)	CNN	25	AF	ECG	MIT-BIH Atrial Fibrillation database	MIT-BIH Atrial Fibrillation Database

First author	Analytic model	Sample	Indication	Imaging	Comparison	Database
Hu et al. (2018)	Boosting algorithm	1861	MPI in CAD	SPECT	True early reperfusion	Multicenter REFINE SPECT registry
Wei et al. (2014)	Custom-built algorithm	83	Noncalcified plaques (NCPs) detection on CCTA	CCTA		Single center
Kranthi et al. (2017)	Boosting algorithm	85,945	CCTA in CAD	CCTA	66 available parameters (34 clinical parameters, 32 laboratory parameters)	Single center
Madan et al. (2013)	SVM	407	Urinary proteome in CAD	global proteomic profile analysis of urinary proteome		Indian Atherosclerosis Research Study
Zellweger et al. (2018)	Custom-built algorithm	987	CAD evaluation	N/A	Framingham scores	The Ludwigshafen Risk and Cardiovascular Health Study (LURIC)
Moshrik Abd alamir et al. (2018)	Custom-built algorithm	923	ED patients with chest pain -CTA analysis	CT Angiography		Single center
Nakajima et al. (2017)	CNN	1,001	Previous myocardial infarction and coronary revascularization	SPECT	Expert consensus interpretations	Japanese multicenter study
Song et al. (2014)	SVM	208	Risk prediction in ACS	N/A		Single center
VanHouten et al. (2014)	Logistic-linear regression, RF	20,078	Risk prediction in ACS	N/A		Single center
Xiao et al. (2018)	CNN	15	Ischemic ST change in ambulatory ECG	ECG		Long-Term ST Database (LTST database) from PhysioNet
Yoneyama et al. (2017)	CNN	59	Detecting culprit coronary arteries	CCTA and myocardial perfusion SPECT		Single center

Coronary artery disease						
Araki et al. (2016)	SVM classifier with five different kernels sets	15	Plaque rupture prediction	IVUS	40 MHz catheter utilizing Dylap (Boston Scientific, Marlborough, MA, USA) with 2,865 frames per patient (42,975 frames) and (b) linear probe B-mode carotid ultrasound (Toshiba sc CNN , Japan)	Single center
Araki et al. (2016)	SVM combined with PCA	19	Coronary risk assessment	IVUS		Single center
Arsanjani et al. (2013)	boosting algorithm	1,181	Perfusion SPECT in CAD	Perfusion SPECT	2 experts, combined supine/prone TPD	Single center
BaumCNN et al. (2017)	Custom-built algorithm	258	ctFFR in detecting relevant lesions		Invasive FFR determination of relevant lesions	the MACHINE Registry
Coenen (2018)	Custom-built algorithm	351	Invasive FFR / Computational flow dynamics based (CFD-FFR)	CT angiography	Invasive FFR / Computational flow dynamics based (CFD-FFR)	5 centers in Europe, Asia, and the United States
Dey et al. (2015)	boosting algorithm	37	Coronary CTA in ischemic heart disease patients to predict impaired myocardial flow reserve	CCTA	Clinical stenosis grading	Single center
Eisenberg et al. (2018)	boosting algorithm	1925	MPI in CAD	SPECT	Human visual analysis	The ReFINE registry
Freiman et al. (2017)	Custom-built algorithm	115	CCTA in coronary artery stenosis	CCTA	Cardiac image analysis	The MICCAI 2012 challenge
Guner et al. (2010)	CNN	243	Stable CAD	Myocardial perfusion SPECT (MPS)	SPECT evaluation and human-computer interaction . One expert reader who has 10 years of experience and six nuclear medicine residents who have two to four years of experience in nuclear cardiology took part in the study	Single center
Hae et al. (2018)	Logistic-linear regression , SVM, RF, boosting algorithm	1,132	Prediction FFR in stable and unstable angina patients	FFR, CCTA		Single center
Han et al. (2017)	Logistic-linear regression	252	Physiologically significant CAD	CCTA and invasive fractional flow reserve (FFR)		The DeFACTO study
Hu (Xijuhua) et al. (2018)	Custom-built algorithm	105	Intermediate coronary artery lesions	CCTA	CCTA-FFR vs Invasive angiography FFR	Single center
Continued						
Stroke						
Abouzari et al. (2009)	CNN	300	SDH post-surgery outcome prediction	CT head		Single center
Alexander Roederer et al. (2014)	Logistic-linear regression	81	SAH-Vasospasm prediction	Passively obtained clinical data		Single center
Arslan et al. (2016)	Logistic-linear regression, SVM, boosting algorithm	80	Ischemic stroke	EMR		Single center
Atanassova et al. (2008)	CNN	54	Major stroke	Diastolic BP	2 CNNs compared	Single center
Barriera et al. (2018)	CNN	284	Stroke (ICH and ischemic stroke)	CT head	Stroke neurologists reading CT	Single center
Becky et al. (2017)	CNN	114	Stroke	CT head	Expert consensus interpretations	Single center
Dharmasaroja et al. (2013)	CNN	194	Stroke intracranial hemorrhage	CT head	Thrombolysis after ischemic stroke	Single center
Fodeh et al. (2018)	SVM	1834	Atraumatic ICH	EHR review		Single center
Gottrup et al. (2005)	CNN , Custom-built algorithm	14	Acute ischemic stroke	MRI	Applicability of highly flexible instance-based methods	Single center
Ho et al. (2016)	SVM, RF, and GBRT models	105	Acute ischemic stroke	MRI	Classification models for the problem of unknown time-since-stroke	Single center
Knight-Greenfield et al. (2018)	CNN	114	Stroke	CT head	Expert consensus interpretations	Single center
Ramos et al. (2018)	SVM, RF, Logistic-linear regression, CNN	317	SAH	CT Head	Delayed cerebral ischemia in SAH detection	Single center
Stitt et al. (2012)	MLP neural networks	584	Stroke mortality	EMR data	Selected variables using univariate statistical analyses	N/A
Paula De Toledo et al. (2009)	Logistic-linear regression	441	SAH	CT Head	Algorithms used were C4.5, fast decision tree learner, partial decision trees, repeated incremental pruning to produce error reduction, nearest neighbor with generalization , and ripple down rule learner	Multicenter Register
Thorpe et al. (2018)	decision tree	66	Stroke	Transcranial Doppler	Velocity Curvature Index (VCI) vs Velocity Asymmetry Index (VAI)	Single center
Williamson et al. (2019)	BOOSTING algorithm, RF	483	Risk stratification in SAH	True poor outcomes		Single center
Xie et al. (2019)	Boosting algorithm	512	Predict Patient Outcome in Acute Ischemic Stroke	CT Head and clinical parameters	Feature selections were performed using a greedy algorithm	Single center

Table 1 presents the features of the comprised trainings, detailing various machine learning algorithms. Additionally, it includes abbreviations for medical conditions and procedures.

FIGURES

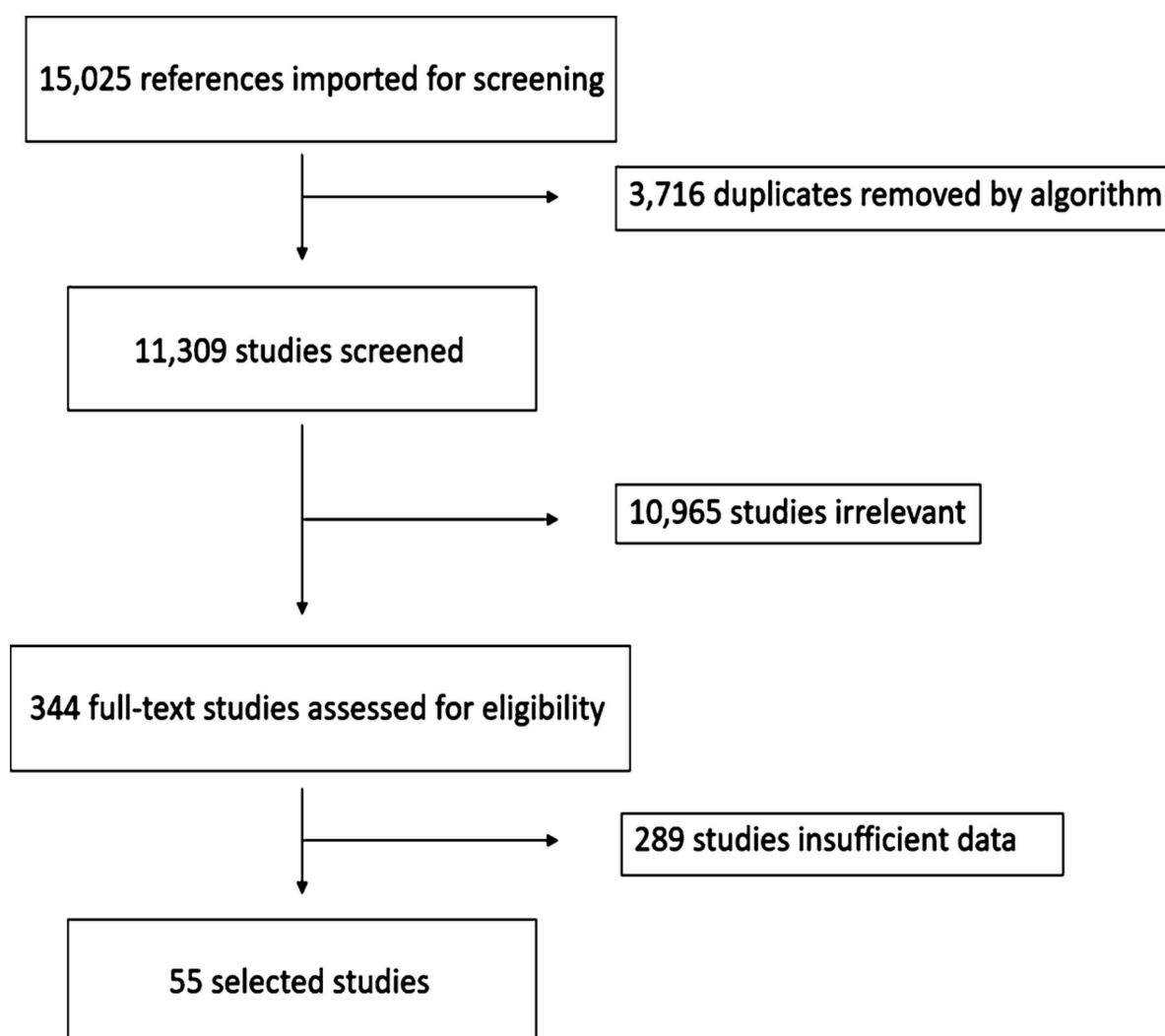


Figure 1 depicts the study design, outlining in a flow chart.

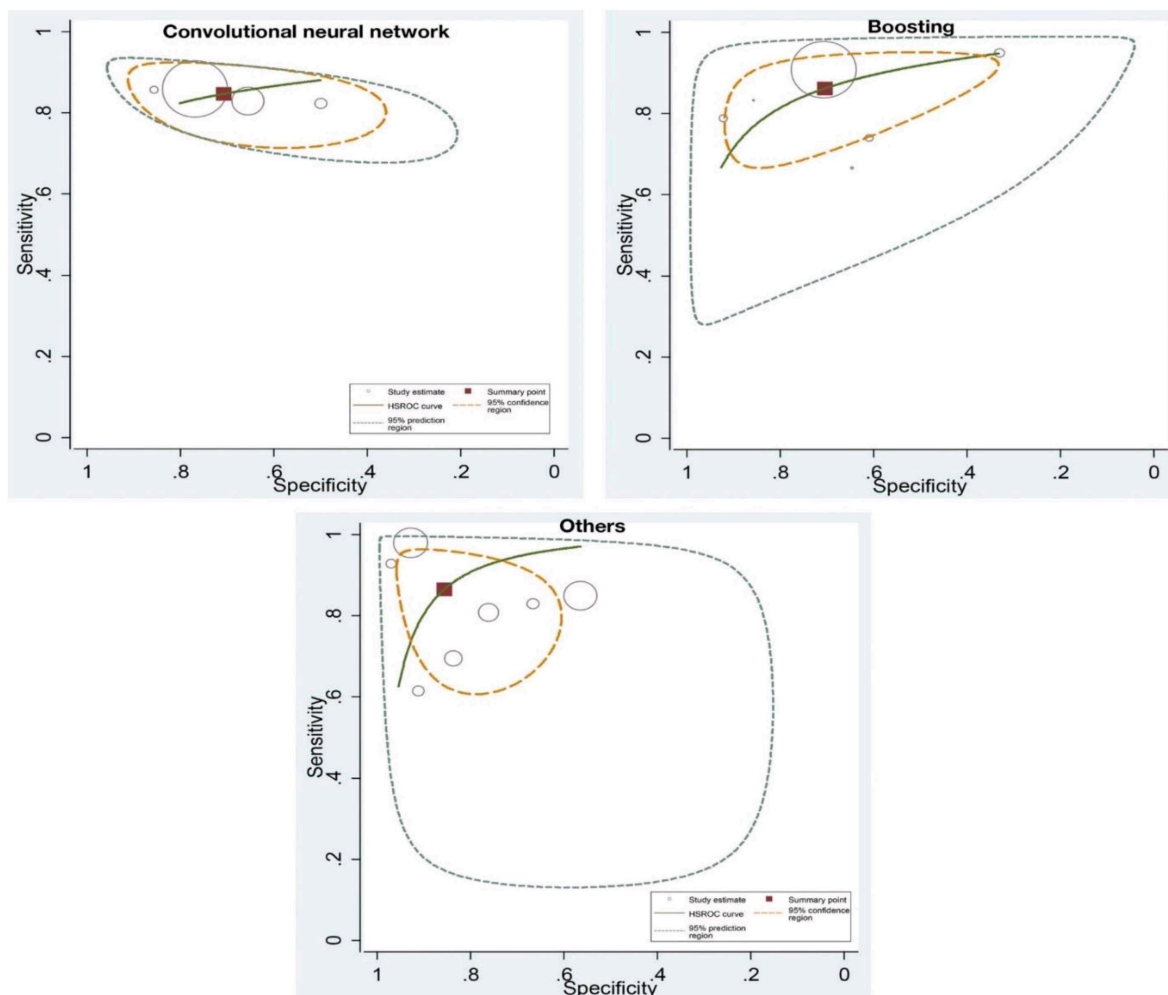


Figure 2 illustrates Receiver Operating Characteristic curve linking various ML replicas aimed at Coronary artery disease forecast. pooled AUC for Coronary artery disease prediction stood 0.87 (95% CI 0.76–0.93) for CNN, 0.88 (95% CI 0.84–0.91) for boosting algorithms, and 0.93 (95% CI 0.85–0.97) for other custom-built algorithms.

B.SOURCE CODE

ARDUINO_CODE:

```
char data;

int in1 = 4,in2 = 5,in3 = 12,in4 = 13;

void setup() {

  pinMode(in1,OUTPUT);

  pinMode(in2,OUTPUT);

  pinMode(in3,OUTPUT);

  pinMode(in4,OUTPUT);


  digitalWrite(in1,LOW);

  digitalWrite(in2,LOW);

  digitalWrite(in3,LOW);

  digitalWrite(in4,LOW);


  Serial.begin(9600);

  delay(1000);

  Serial.print("start");

}

void loop() { // READ DATA
```



```

if (Serial.available())
{
    data = Serial.read();
}
if(data == '*')//forward
{
    Serial.print("left");
    digitalWrite(in1,LOW);
    digitalWrite(in2,HIGH);
    digitalWrite(in3,LOW);
    digitalWrite(in4,LOW);
}
else if(data == '#')//backward
{
    Serial.print("right");
    digitalWrite(in1,LOW);
    digitalWrite(in2,LOW);
    digitalWrite(in3,HIGH);
    digitalWrite(in4,LOW);
}
else if(data == '$')//right

```

```

{
    Serial.
    print("f
    orward
    ");
    digital
    Write(i
    n1,LO
    W);
    digital
    Write(in
    2,HIGH
    );
    digital
    Write(in
    3,HIGH
    );
    digital
    Write(i
    n4,LO
    W);
}

else if(data == '%')//left
{
    Serial.pr

```

```
int("bac  
kward");  
digitalW  
rite(in1,  
HIGH);  
digitalW  
rite(in2,  
LOW);  
digitalW  
rite(in3,  
LOW);  
digitalW  
rite(in4,  
HIGH);  
}
```

```
else if(data == '~')//stop
```

```
{
```

```
Serial.print  
("stop");  
digitalWrite  
(in1,LOW);
```

```
digitalWrite  
  
(in2,LOW);  
  
digitalWrite  
  
(in3,LOW);  
  
digitalWrite  
  
(in4,LOW);  
  
}  
  
Delay(100);  
  
}
```