Design and Control of Automated Medical Bed Systems Using IoT

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Chapter 1

Introduction

The research is based on the use of IoT technology to solve different types of problems related to Medical system.The internet of things can change the medical system.

Hospital beds are medical devices that are specially designed for patients having various types of treatments and for medical staff using different controls for the medical system.

People do not have the ability to move when they are in bed. The main purpose of the smart medical bed system is to help people who cannot move freely from one place to another place without help [1].

The goal of the project is to design and develop an intelligent medical system with a sensor system that can be integrated into the monitoring of medical beds. If the patient is near the emergency room, the control panel will send a signal to the bed. Automatically enter the emergency room; if the patient needs urgent care, the bed will be transferred to the emergency room; on the other hand, if the patient needs a conventional cabin, the automatic bed will be placed in the ordinary cabin. The process will be done automatically.

This project is based on IoT technology. Smart medical bed systems based on IoT technology are a new type of integrated function for the medical system. The bed location will be determined by IoT Technology.

The features of IoT technology such as comprehensive perceptron, reliable transmission intelligent processing and soon provide techniques support platform for the construction and implementation of smart hospitals.

A thing in the internet of things objects can include people with heart monitor implants, farm animals with biochip transponders, cars with built-in sensors that warn the driver of low tire pressure, or other objects. Naturally or artificially, it can be assigned an Internet Protocol address, and it can transmit data over the network.

1.1 Motivation

We designed an automated controlled hospital bed using an Internet of Things application to reduce patient attempt and arrival time, as well as to make the patient more comfortable and eliminate bed suffering.

We visited many hospitals. At present, the condition of patients in medical facilities is very deplorable. In emergency room has many patients but they do not get any health care.

So to solve this problem we think of a project like this, to develop a medical system where no one will be needed to bring the patients. The automatic process will move a bed to the emergency room then bring the patient. Our project is a completely new system.

1.2 Objectives

The proposed project is assumed to achieve these objectives:

- To design a user interface to help patients.
- To design an automated Medical system.
- To test the robotic system on a medical and compare the usefulness with the manual medical systems
- A patient bed should be designed to be able to move in directions required using the Microcontroller system and other electrical components which in its turn send orders about how the direction of the patient bed must be.

1.3 Advantage of proposed system

Advantages of the Automated Medical System are:

- Instant services, the system is less time consuming.
- The patient easily moves from one place to another place.
- The system will provide information in a short amount of time.
- The system enables us to precisely describe the information that we seek.
- The proposed system reduces the problem of sophistication.

1.4 Internet of Things(IoT)

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction[2].

1.5 IoT Webpage

A webpage is a platform which is used to communicate with the automated medical bed through wireless medium to call the medical bed at the main entrance for picking up the patient. Building up a webpage html, css and django programming required.

1.5.1 HTML and CSS

HTML (the Hypertext Markup Language) and CSS (Cascading Style Sheets) are two of the core technologies for building Web pages. HTML provides the structure of the page, CSS the (visual and aural) layout, for a variety of devices. Along with graphics and scripting, HTML and CSS are the basis of building Web pages and Web Applications. HTML is the language for describing the structure of Web pages.CSS is the language for describing the presentation of Web pages, including colors, layout, and fonts.

1.5.2 Django

Django is a web development framework for python which offers a standard method for fast and effective website development. It is high level web framework which allows performing rapid development. The primary goal of this web framework is to create complex database driven website.

1.6 API

Application Programming Interface (API) is a software package interface that enables two applications to act with one another with no user intervention. API is an assortment of software functions and procedures. In straightforward terms, API suggests that a software code which will be accessed or executed.

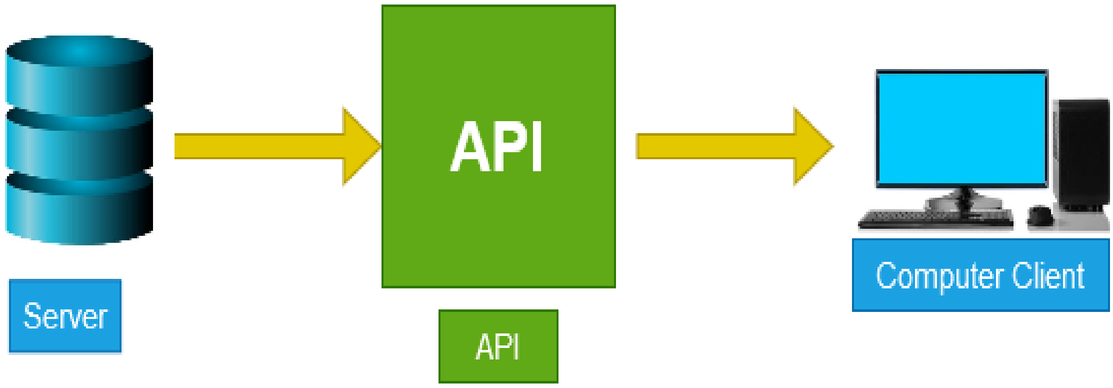

Figure 1.1: Application Programming Interface[3]

API is outlined as a code that helps two completely different software to speak and exchange information with each other. It offers merchandise or services to communicate with other products and services while not having to grasp however they're implemented.

1.7 Webscrapping

Beautiful Soup is a Python package for extracting data from markup languages such as HTML, XML, and others. It integrates with your preferred parser to offer fluent navigation, search, and modification of the parse tree. It is normal for programmers to save hours or even days of effort.

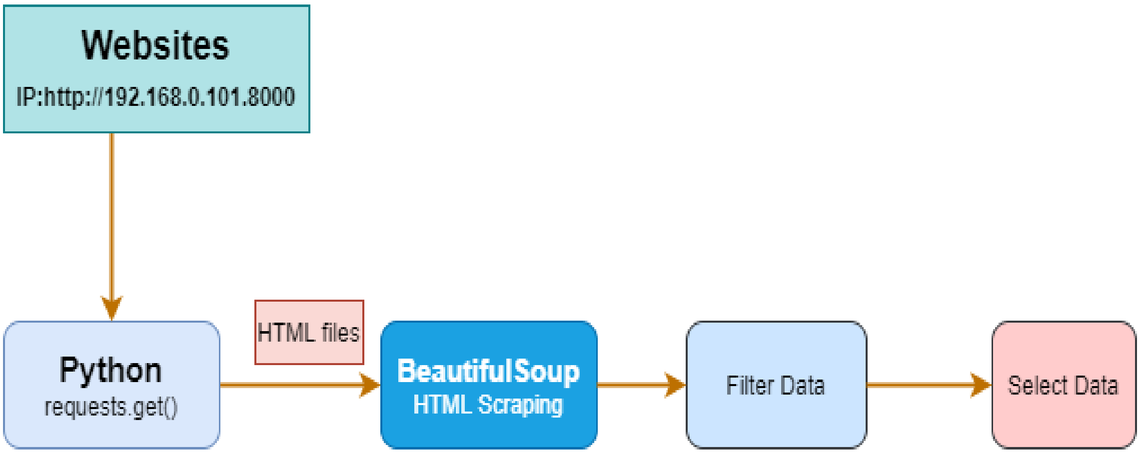

Figure 1.2: Beautiful Soup Library[4]

1.8 Raspberry PI

The Raspberry Pi has the ability to interact with the outside world and has been used in a wide array of digital developers projects from machines and parent detectors to weather stations and birdhouses that tweet with infrared cameras. We use raspberry pi for controlling the medical bed[5].

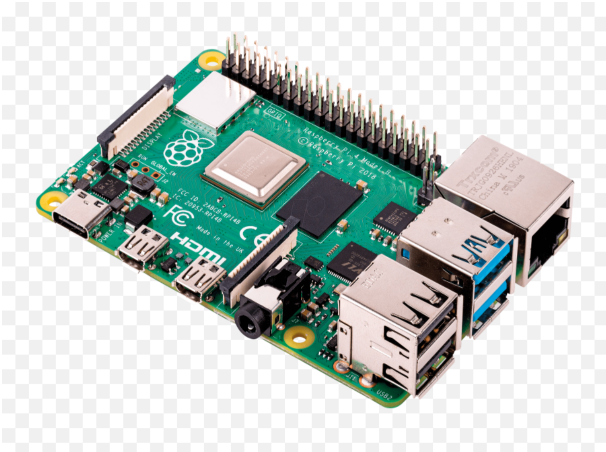

Figure 1.3: Raspberry PI[6]

GPIO pin out of the Raspberry PI:

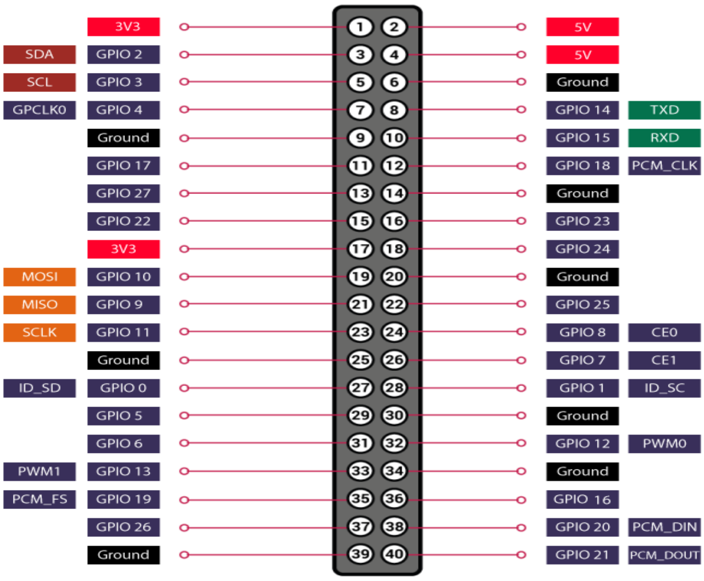

Figure 1.4: GPIO Pinout

1.9 QR reading using ZBar Library

ZBar is a free software suite that can scan QR code or bar codes from a variety of sources, including video streams, image files, and raw intensity sensors.

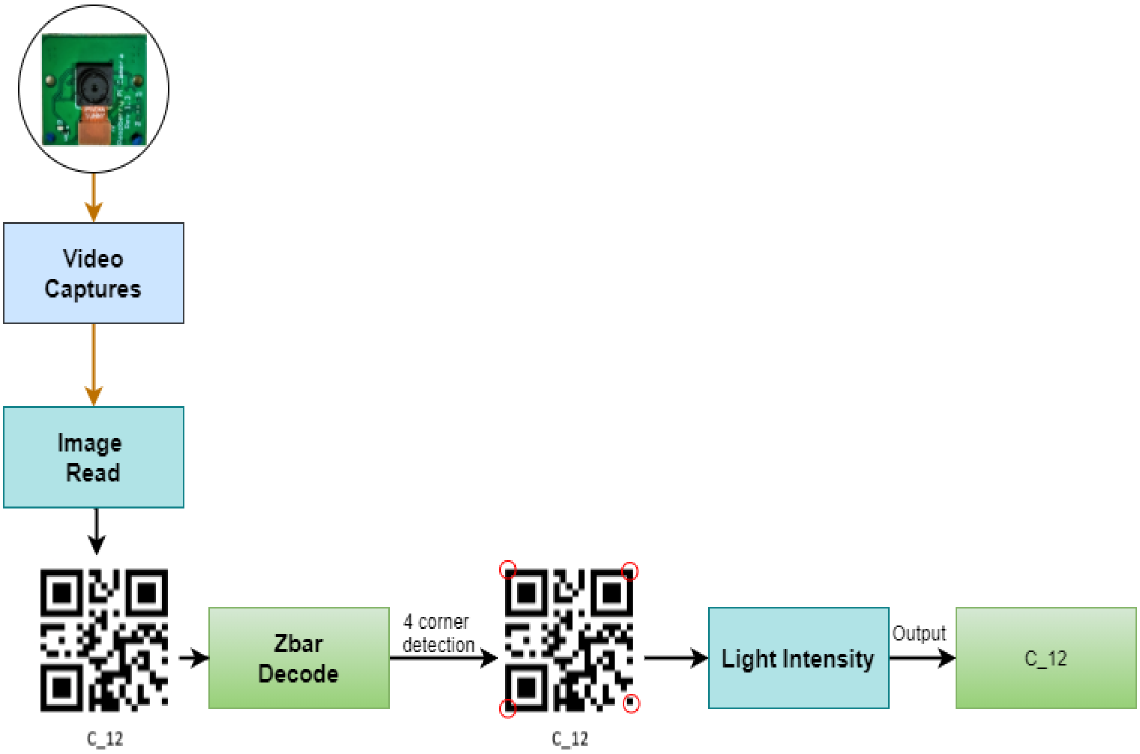

Figure 1.5: QR reading using ZBar Library

It captures video and read image of QR code from stream video. Then the Zbar library detects the four corners of the QR code and detects the QR code. According to the Light intensity of the QR code, it reads the value behind the QR code.

Chapter 2

Related Works

In this Chapter we have reviewed some works done on Medical Bed Robots. The advantages, disadvantages, technologies used and how the drawbacks can be overcomes have been discussed.

Based on the working principles and features, these papers can be broadly classified in the following classes:

2.1 Hospital Management System

According to Toussaint (2015), hospitals can't improve without better management systems. In Toussaint's perspective, management is a significant part of today's cost and quality crisis in health care. This is the reason why suitable hospital needs and appropriate medical management must be present to deliver applicable healthcare facilities.
According to Agnes (2011) there must be a planned approached towards work. And thus, the activities within the hospital must be well planned and organized. In line with this, the researchers found out that the level of accuracy in handling hospital information must be done accordingly and accurately. Conclusively, the errors are not completely eliminated, but they are reduced[7].

2.2 Automated wheelchair navigation

In this work, a wheelchair navigation system using Hidden Markov Model (HMM) is developed to help the patients suffering from restricted mobility. Different physical features are extracted and identified using electrooculography (EOG) signal traces which are then used as inputs to support vector machine (SVM) classifiers. The outputs obtained from these classifiers are then considered as observations to the HMM. The model then decides the state of the system and then generates commands according to that navigating the wheelchair [8].

Strengths: The semi-automated wheelchair has obstacle avoidance sen- sors which take EOG signal traces from the suffering patients to navigate the wheelchair. Those EEG signals collected from the scalp through the facial ex- pressions at different locations of the users. The features extracted from the EOG traces are used for classifying different facial states and then are used as inputs to support vector machine (SVM) classifiers, which eventually are used as observations of HMM to generate commands for navigating the wheelchair. A sliding window is used to capture important signatures in the traces with high classification rates. The proximity sensor in the wheelchair can move forward and backward in those directions. It is to be mentioned that the system achieved an average classification rate of 98% and average execution time of less than 1 s when tested with online data.

Weaknesses: This system is not tested with real patients who suffer from mobility disorder. This work exploits a new brain-actuated wheelchair mechanism using a P300 neurophysiological protocol and automated navigation. The user faces a real-time virtual reconstruction of the scenario in a display to concentrate to reach the location of the space. A neurological phenomenon elicited from the visual stimulation process and the target location is detected using the electroencephalogram (EEG) signal, which is then transferred to an autonomous wheelchair system that drives to the desired location avoiding obstacles. The obstacles in the environment are detected using the laser scanner, which gives the user the flexibility to utilize the system in unknown and evolving scenarios. The overall experiment was done with several evaluation studies, which reports that the participants were able to operate the system successfully, relatively easily and efficiently [9].

2.3 Noninvasive brain- actuated wheelchair

Strengths: A new brain-actuated wheelchair mechanism, where the user faces a real-time virtual scenario in a display to reach the location of the space. A neurological phenomenon elicited from the visual stimulation whereas the target location is detected using the electroencephalogram (EEG) signal. This signal is then transferred to an autonomous wheelchair system that drives to the desired location avoiding obstacles, which are detected by a laser scanner. This prototype is experimented with five participants in three steps: screening, virtual-environment driving, and driving sessions with the wheelchair. Several evaluation studies reported from the experiment are: 1) a technical evaluation of the device and all functionalities, 2) a users' behavior study and 3) a vari- ability study. It is mentioned that all the participants are able to operate the device successfully with relative ease and showed a high adaptation with great robustness of the system.

Weaknesses:The BCI-based online error-detection system is not inte- grated and the virtual reconstruction display can be substituted with real-time video for non-colocated users. This paper presents SIAMO (Spanish acronym for Integral System for As- sisted Mobility) project, a work as an assistance device for the guidance of autonomous wheelchairs for the disabled or the elderly. The electronic systems of the wheelchair have been designed to meet a wide range of needs experi- enced by users. The most important feature is modularity which enables the systems to be adaptive to the specific needs of the users according to the types and degrees of handicap involved. The system includes a user-machine interface and a complete sensory subsystem (ultrasonic, infrared, vision etc) including a strategy of control and navigation, allowing different alternatives for wheelchair guidance and ensuring user safety with comfort [10].

2.4 Arduino based voice-controlled automated wheelchair

Strengths: The human-machine interface (HMI) between the user and the chair is given the most priority in this work since it has the most challenging part that the user faces to drive the chair. It is also considered that the user can react if any type of problem arises that may represent a risk despite the degree of autonomy. Safety and comfort are the most important aspects of the SIAMO project. Comprising ultrasonic and infrared sensors, cameras and position sensor devices (PSDs), a sensory system is designed to allow the detection of obstacles, holes and other objects. Moreover, flexibility and modu- larity have been also considered for which a distributed architecture is designed. Considering each user's needs, the user's type and degree of disability, modu- larity guarantees independence from both hardware and software perspectives of the whole system, allowing module manufacturers to offer different versions of wheelchairs to the users adapted to any specific needs.

Weaknesses:Infrared systems have some disadvantages in these environments where strong radiation sources exist over the same wavelength of the laser. Strong solar radiation or windowed corridors with direct sunlight in out- door spaces can be an example of this type system. This work involves an Arduino-based voice controlled automated wheelchair where the design is developed with a voice recognition system, allowing the physically disabled person to control the wheelchair by voice commands. The design also provides additional features such as obstacle detection considering safety. A GSM based navigation system is developed to track and send notifica- tions to the automated wheelchair, resulting in improved usability of the system. The system does not need any wearable sensors to control the movement such as EEG, EMG and EOG sensors according to several research studies. Those experiments were done using complex signal processing techniques with an extra bulky computing system attached with the wheelchair [11].

2.5 Controlling an automated wheelchair via joystick

Strengths: To implement the design of the wheelchair system, Arduino Mega2560 with VR3 speech recognition module, SIM900A GSM module and relay based motor controller circuits are used. In the proposed design, the speech processing is performed using the available integrated speech processing module, removing the necessity of any bulky complex extra computing device. Moreover, the proposed design is relatively cheaper and efficient to implement compared with the existing techniques which will help the physically disabled people in developing and under developing countries.

Weaknesses: There are spaces for improvement for positioning the speech recognition and motor driver module to maintain the proper balancing of the wheelchair for the patients. This work encourages the smart driving assistance algorithms to navigate an automated wheelchair properly in complex situations. The benefits have been also proved from the application of a newly developed driving assistance module. When any obstacle blocks the user-commanded way, the module significantly alters the translational and rotational velocities in order to improve driver- performance, preventing the collisions along the way [12].

2.6 Sensors based automated wheelchair

Strengths: The progress has been made in two main aspects in this work. Firstly, the new wheelchair is equipped with a differential drive, showing a completely different description of the possible motions of the wheelchair and the safety areas. Secondly, the laser range sensors are used instead of sonar sensors to maintain the full usability of the original wheelchair intact. This is one of the major drawbacks that smart wheelchairs prototypes have which has been solved by this work.

Weaknesses: The evaluations are not repeated with real users in this work. Physically challenged people are unable to steer their wheelchair with the assistive technologies available. Apart from the existing methods, they require efficient and precise control which seem impossible sometimes. Different control systems are developed and under developing process for people with disabilities. In this work, each eye having an IR transmitter and receiver, will transmit the light over iris and receive the reflected light. The controller will perceive the user's intention of wheelchair movement depending upon the intensity of reflected light falling on the receiver and take actions according to that. The controller can move forward, left or right as long as the IR receiver receives the directions from the user. This system helps the patients to give command over the chair including its direction of movement. The system will also sense and alarm the users about the obstacles to avoid severe consequences in the path, enabling the patients to move in environments with ramps and doorways of little space using communication between human eye iris and IR sensor [13].

2.7 Control of a wheelchair in an indoor environment

Strengths: The proposed approach in this work is useful for physically challenged people who cannot move their wheelchair by themselves. The wheel chair model in this project contains an in-built micro-controller and eye ball sensing system, enabling right, left, forward and reverse functionalities. The system is designed in a way that can move freely without support from external, facilitating the patients to have their own movements.

Weaknesses: The major drawback of this work is that a lot of strain is created to the eyes since the wheelchair needs eyeball movements as inputs to the controller. This work presents an integration of a brain-computer interface (BCI) with automated navigation techniques. The candidate destinations are generated automatically based on the existing environment. In this system, the user selects a destination using a motor imagery based or P300-based brain-computer interface. The navigation system plans an easy, efficient and safe path and navigates the wheelchair to the destination according to the planned destination. The user can issue a stop command with the interface while moving the wheelchair. Moreover, this system is adaptive to the changes in the environment. Experi- ments based on motor imagery and P300 have been executed to demonstrate the effectiveness of the system [14].

2.8 Autonomous navigation system

Strengths: An intelligent wheelchair combined with an motor imagery or P300-based brain-computer interface and an autonomous navigation system which are used for selecting the candidate destinations. The autonomous nav- igation system plans a path and drives the wheelchair to the destination ac- cording to the determined destination and the current location. The workload is substantially alleviated since the user does not have to pay attention while controlling during the navigation period. The system is adaptive to the changes in the environment such as newly added furniture due to the automatic genera- tions of the candidate destinations and paths detected by two webcams. A stop command via the brain-computer interface can be executed issued by the user whenever necessary.

Weaknesses: The main drawback of our proposed approach is that the wheelchair is only suitable for a room equipped with webcams.

2.9 Automated Hospital Ward Management system interacting with mobile Robot platform WD-BOT

Every process is automated in the Healthcare industry. Development of the automatic system, researchers showed its success in the hospital environment. In 2018, Srilanka et al. [4] described an automated ward robot for the hospital management system.AHWMS built a database management system and a smart mobile application that run by wireless networks.

This study describes a revolutionary intellectual Automated Hospital Ward Management System (AHWMS) for a hospital ward based on the WDBOT mobile robotic platform. Due to the demanding work load and limited number of staff, the requirement for an automated system containing an assisting robot for executing duties in the hospital system is critical for doctors, nurses, patients, and other healthcare assistants.

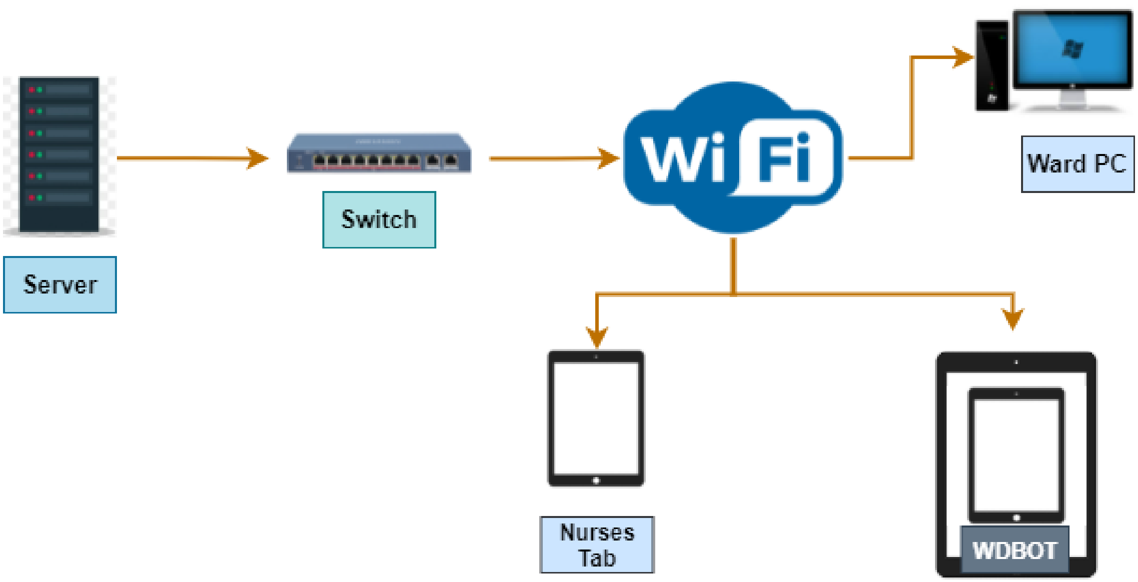

Figure 2.1: Automated Hospital Ward Management System

The goal of this study is to develop an autonomous robotic automaton solution to improve ward administration, medicine management, and distribution operations. With the help of controlling, image analysis, processing, and communication, AHWMS communicates with WDBOT through a wireless network to do the aforementioned activities. The system was verified using simulation and physical modeling of some of the components. This system demonstrates how its use can improve the current hospital ward management system's effectiveness.

The user devices communicate with the server through the web application.The ward server is connected to the hospital server that's why doctors can see the patient information and can provide service on time[15].

User interface was tested with the help of 30 users and their feedback was recorded as 73% for efficiency.

2.10 Smart Hospital based on Internet of Things

In 2012, China et al.[5] described smart hospital system based on Internet of Things to overcome the limitations of the present hospital information system which brings an absolute and rooted payoff for the present diagnosis and treatment mode in hospital.

Smart hospital composed of perception layer, network layer and application layer. Perception layer consist of data acquisition layer and access layer. The data acquisition layer stands for picking up the data of nurses, doctors, patients, pharmaceuticals, medical equipment, psychological information and so on. The access layer stands for transmitting the data and access it from global object-conjunction network. Network layer consist of network transmission platform and application platform. Application layer includes two part which is respectively hospital informatization application and management decision and application[16].

2.11 The development of a remote control system for adjusting the position of an electric bed remotely using a mobile application

Many patient monitoring devices are designed to keep track of vital signs like blood pressure, heart rate, and temperature. This method works by gathering patient data and sending it to clinicians through Wi-Fi.

Joe Kittan, a British inventor, has created a linen bed that vibrates to aid sleep and can be set with a smartphone to vary its temperature by rising or reducing it. The bed can also be linked to screens that project various images onto the ceiling.

The bed, according to a recent story in the Daily Mail, was made up of little air balloons surrounded by sponges to adapt to all weights and sizes. The bed will set you back £ 1000. The bed also has a fire alarm to ensure that the user is protected.

The bedtime thought of increasing needs to improve the family's quality and qualities motivated the 52-year-old British project developer. Users, for example, are satisfied with bed temperature management, according to him.

The ability to connect the in-bed vibrator system to recreational games expands the range of possibilities for users. If a bedridden person is playing an electronic racing game, for example, he may experience bumps and bumps. The bed has a pressure controller and massage options, as well as options to connect to Wi-Fi networks and adjust the scenario, similar to hospital beds. When the user sleeps, bed programs and applications turn off automatically.

Joe Kittan adds, "I got tired of buying different varieties of families that would be ruined after a while." And I was in pain and couldn't seem to find a solution, so after years of dealing with the situation, I came up with this comfortable bed and entertaining at the same time.

Linen stresses comfort in addition to luxury. The bed contains features that improve safety. The primary concept behind this bed is that it operates through an electronic application that can be utilized with any ”log” family system.

Our goal is for everyone to be able to benefit from this bed and afford it at a fair price. Because of its flexibility and temperature control, the bed is ideal for patients who live at home. Most patients benefit from being able to stay at home.

Showcases in Birmingham, United Kingdom, as a producer in the British Department of Inventions. Designer Kitan claims he worked on the project for eight years and pondered about it when he couldn’t sleep at night, hoping to wish his staff nice dreams.[17]

2.12 Internet of Things in Smart Healthcare

This paper suggested a cloud-based IoT enabled smart cognitive healthcare system that can perform continuous and wireless EEG monitoring and processing of the user's EEG data. The information gathered is then examined in real time so that emergency services can be informed if the user's health becomes urgent. To determine the user's state, the suggested healthcare system can recognize facial movements, activities, conversations, EEG reports, and gestures.

Based on bimodal input, this study developed a strategy for detecting abnormal voices. The speech signal and the EGG signal are used as inputs to the procedure. The suggested VPD system captures spectrograms from signals and sends them to a CNN model for analysis. The collected features from the two modalities are later combined and supplied into the BiLSTM model. The proposed system obtained higher than 95% accuracy, precision, and recall, according to the trial data. Other related systems were also outperformed by the system. It was proven that bimodal inputs outperformed single inputs.[18]

Chapter 3

Methodology

The methods of the research project are described in this chapter. The work that has been already done and the future work that is expected are described in this chapter.

We designed our project using the Internet of Things. We made a database system for collecting the information in our automated medical bed systems. Where database store the state value of medical bed and give a feedback to webserver. Webpage is used to call the robotic medical bed at the gate of hospital and pick the patient from gate and go to its own position using vision recognition system and line following system. Here we will use a weight sensor and a temperature sensor for detecting the patient is picked or not. Also if any patient need to surgery then the bed will automatically shifted to OT according to server data. The system work as the following figure.

3.1 Block Diagram

In this project we will use automated medical beds to service the patient using the Internet of things. It was added to the basic control unit on the bed.
The control unit that receives a commands of motion via Wi Fi, then sends to receive the signal from Wi Fi and analyze it ,then send control signals to the medical bed.

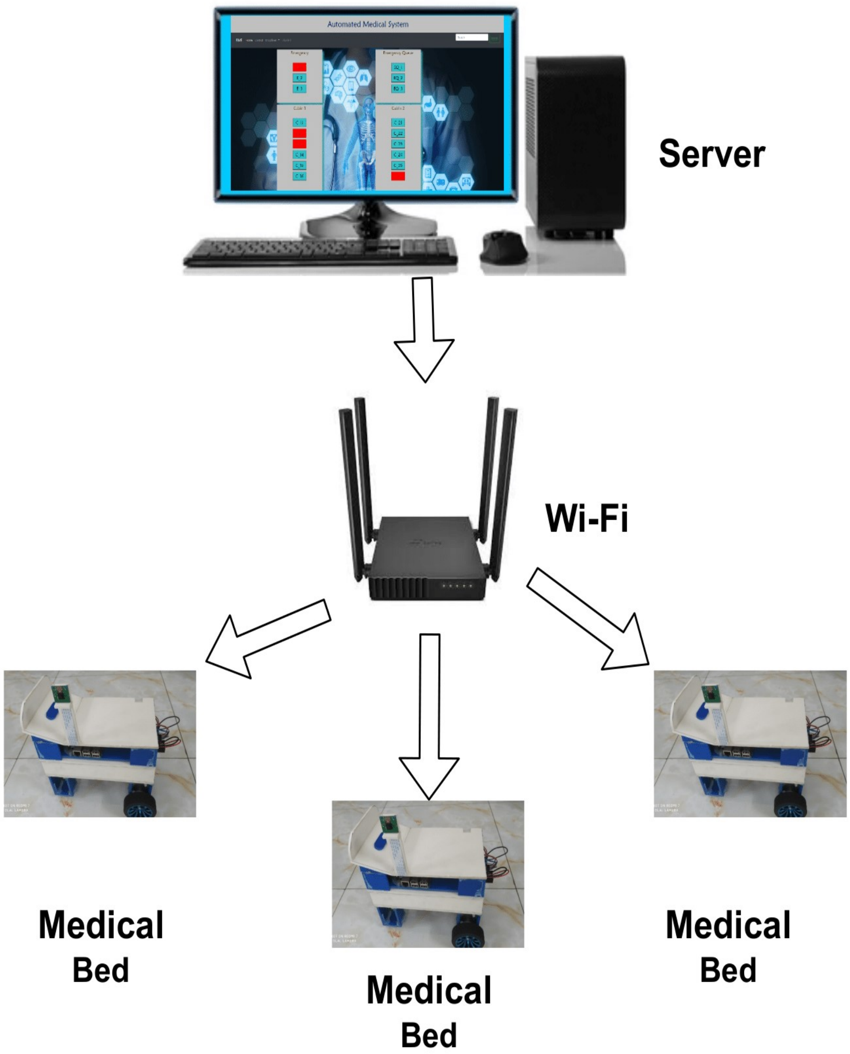

Figure 3.1: System Design Block Diagram

The Figure 3.1 shows the system parts design, and how they interacted with each other via Wi-Fi connection.

3.2 Simulation

The system was to be designed to be a web application. We built a webpage for this project.Database system was designed using HTML ,CSS and Django Programming.
Using HTML and CSS programming we developed the frontend of a medical webpage . At the fronted we designed the layout and the element of the webpage.Using Django Programming we developed the backend of a medical webpage .Where we built the database in the backend.

3.2.1 Webpage

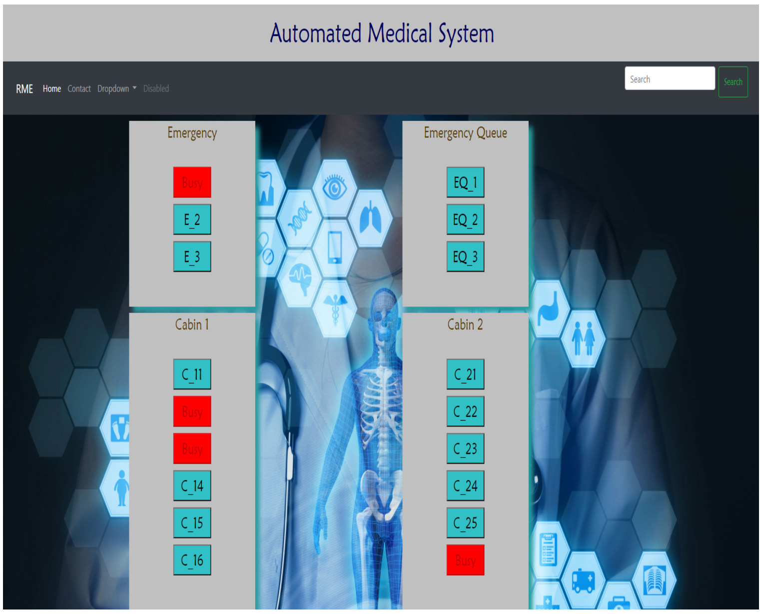

Figure 3.2: Medical System Webpage

This figure represents the front page of the database system. In this figure we show if the medical bed is busy or free.

3.2.2 Medical Bed

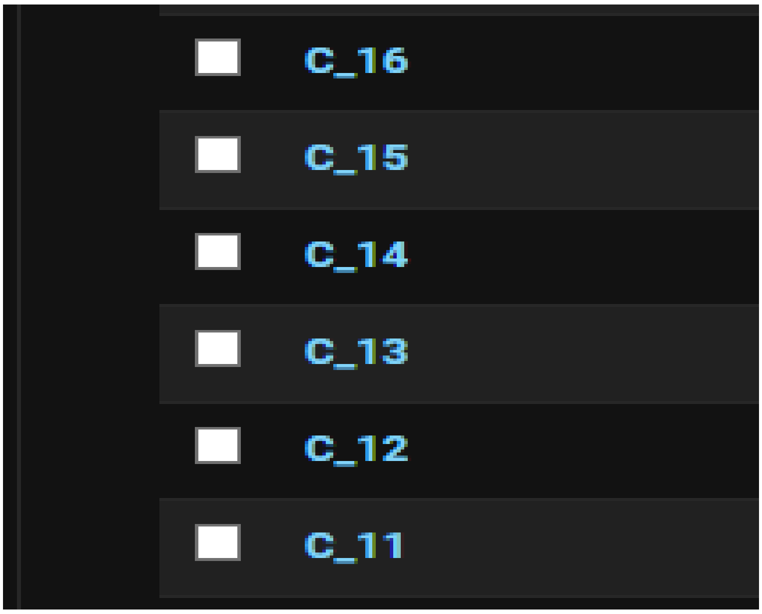

Figure 3.3: Medical Bed Database

This figure represents the structure of the database which will host to the local server and connect the robot using IoT.

3.2.3 QR Code Simulation Result

Identification of Cabin 1 and Position 2.

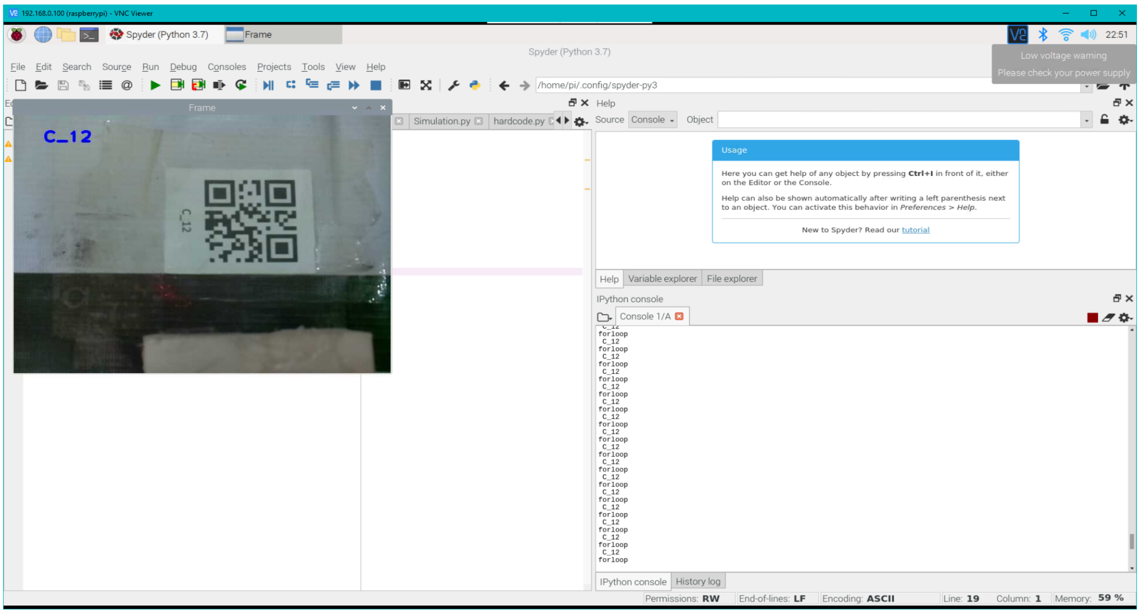

Figure 3.4: C_12 Position Identification

Identification of braking position.

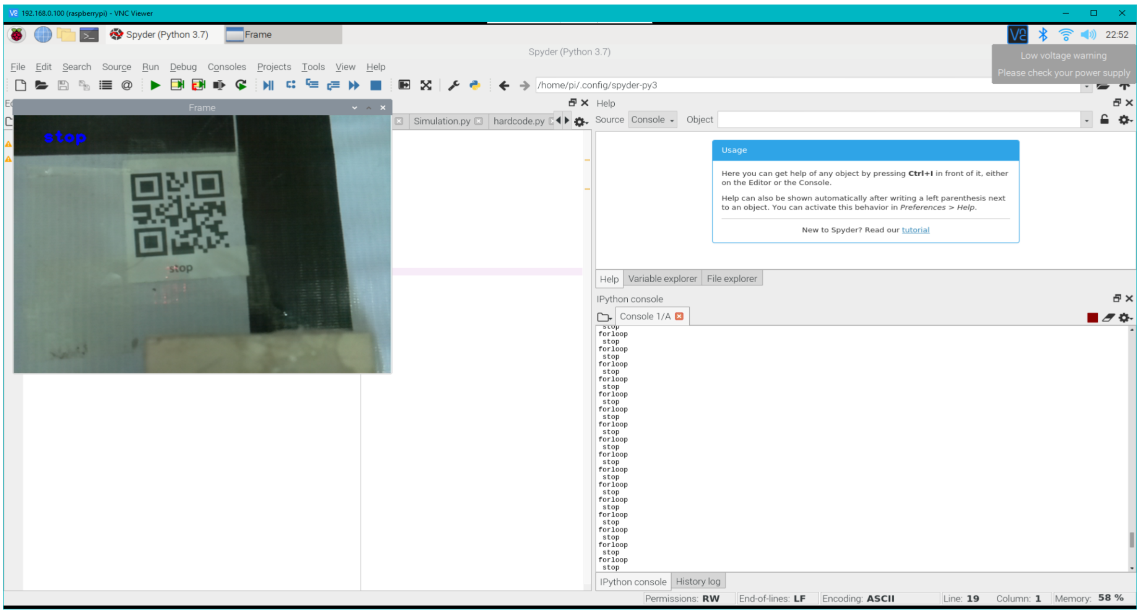

Figure 3.5: Braking position Identification

3.2.4 Medical bed free or busy

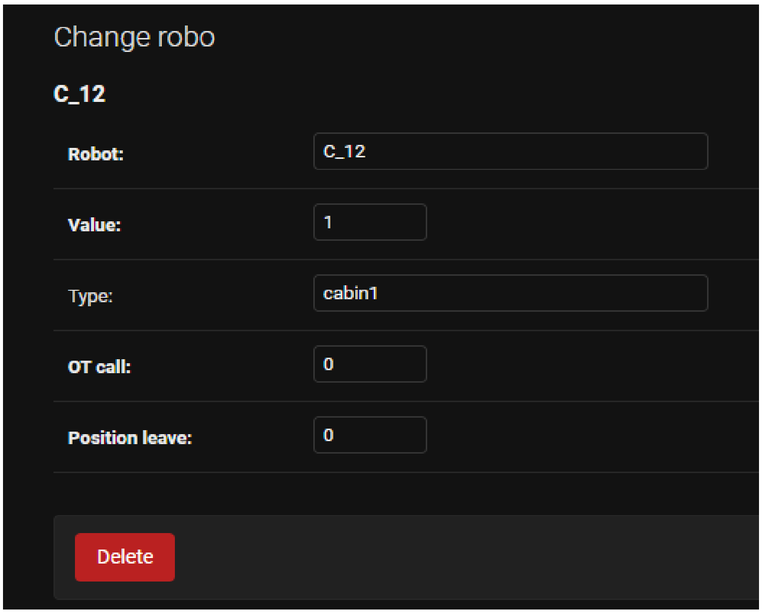

Figure 3.6: Medical Bed free or busy

In the database system we gave some instructions for controlling medical robots.The robot will show busy when there is one value in the database. The robot will free when there is zero value in the database. We store all the information about robots in our database system.

When server value is 0 and position leave is 0 then the simulated result is shown below:

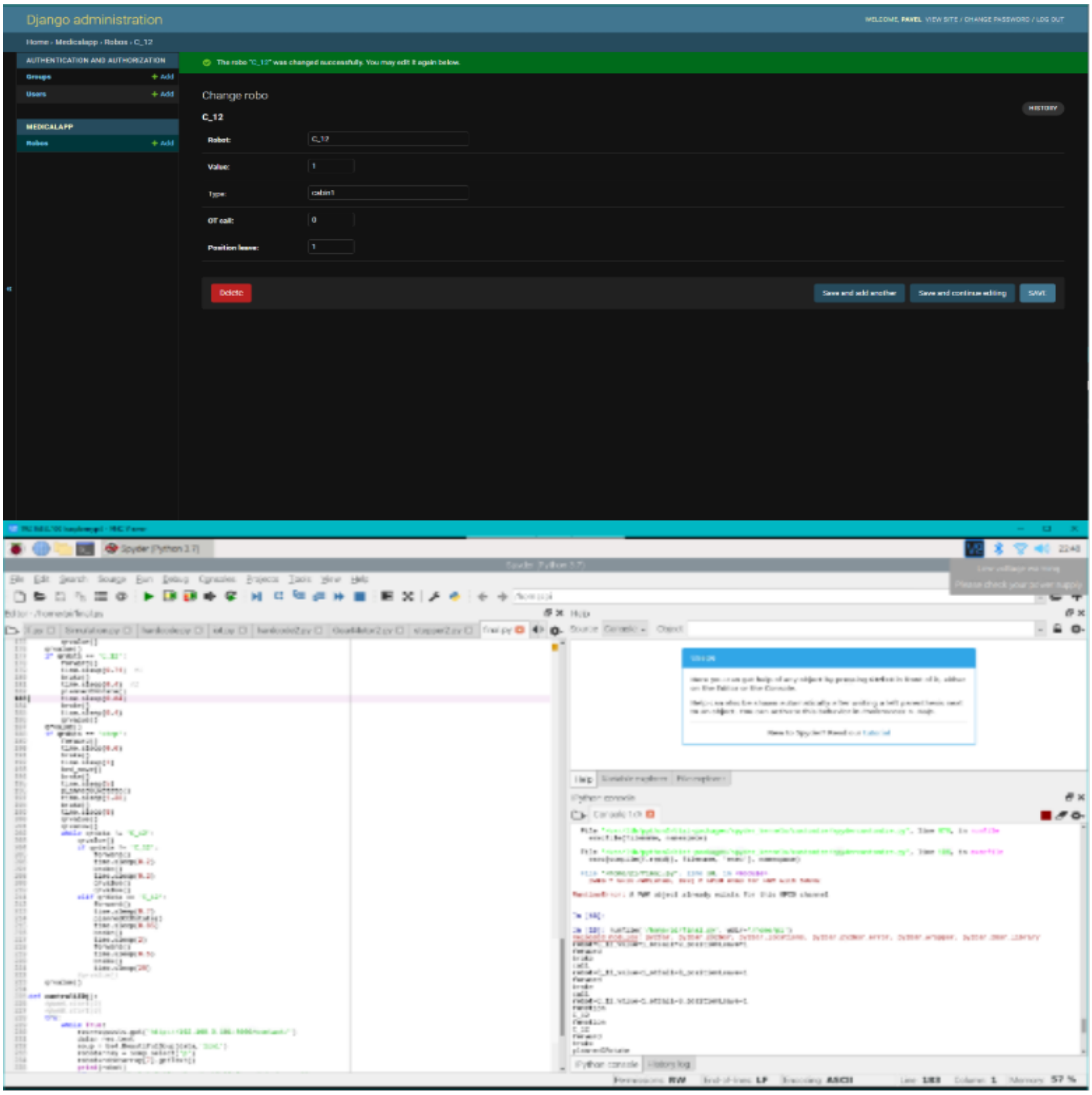

Figure 3.7: Simulation result 1

When server value is 1 and position leave is 1 then the simulated result is shown below:

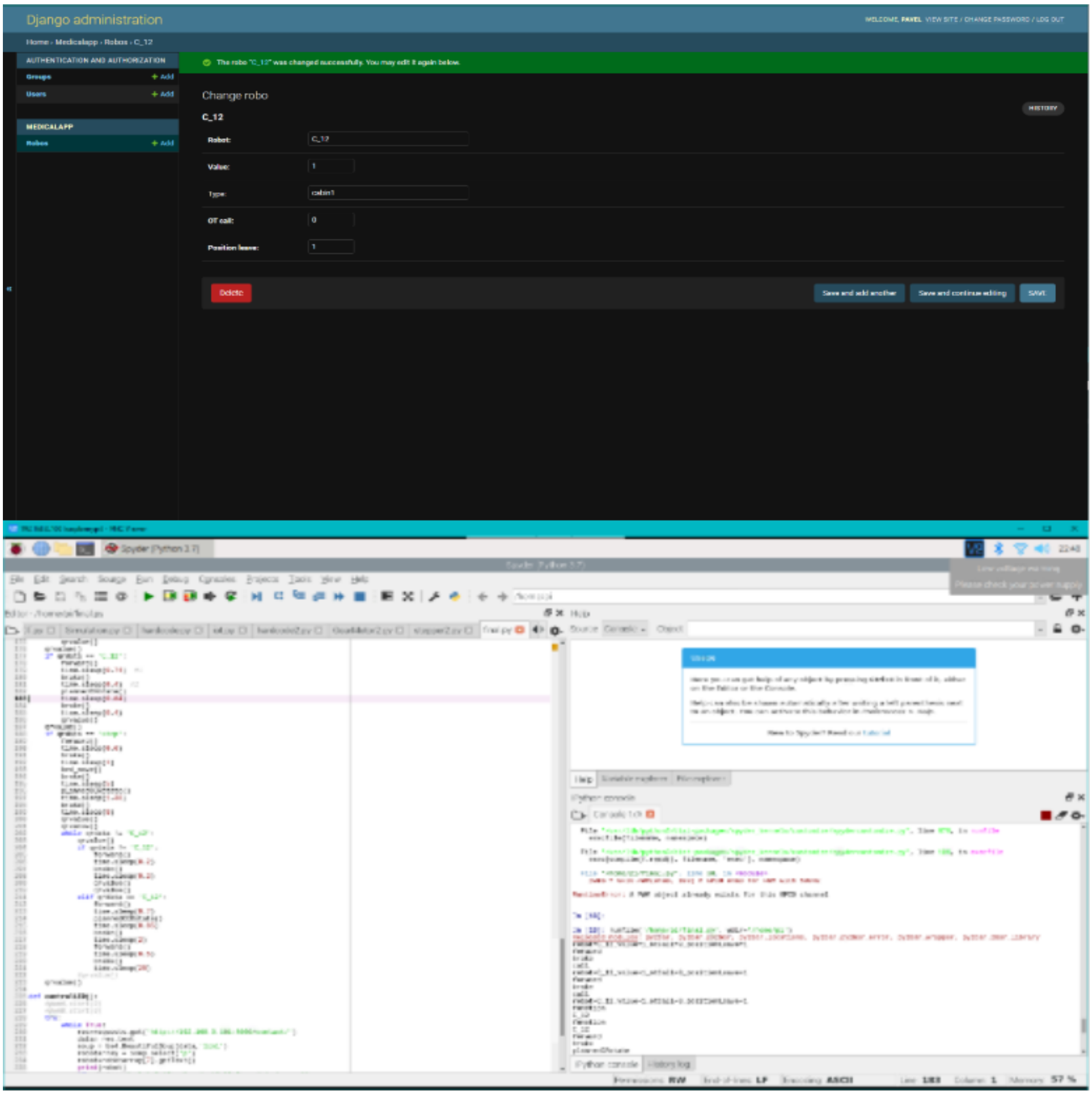

Figure 3.8: Simulation result 2

We remotely controlled medical bed using a raspberry PI from a webpage.The webpage was published by a web server using a port and an unique IP address. Using this unique IP address we can access the webpage and also control the medical bed.For accessing medical webpage the accessing device and the raspberry pi should have to connect through a common router.

3.2.5 Programming

Web scraping refers to the extraction of data from our medical webpage which communicates with medical server. Beautiful soup is a popular library for web scraping.We used a beautiful soup 4 python library.

```
from bs4 import BeautifulSoup
soup = bs4.BeautifulSoup(data, 'lxml')
robotarray=soup.select('p')
robot=robotarray[16].getText()
```

Beautiful Soup library reads the page from the web server through IP address. Then we assigned the IP address in the request variable and took the text as data. Beautiful Soup library filtered the actual data and assigned it to the soup variable. Then we stored all data in the robot array variable. If the robot value is cabin251 then it moves forward. On the other hand , if the value is cabin250 then it will not move.

3.2.6 QR Code Reading

This is the flow chart of QR code detecting.

Step1: Start the medical bed

Step2: QR Code is going to be scanned.

Step3: When the QR code is scanning the bed.

Step4: then the medical bed will move.

Step5: If not, then it goes back and scans.

Step6: Stop the medical bed

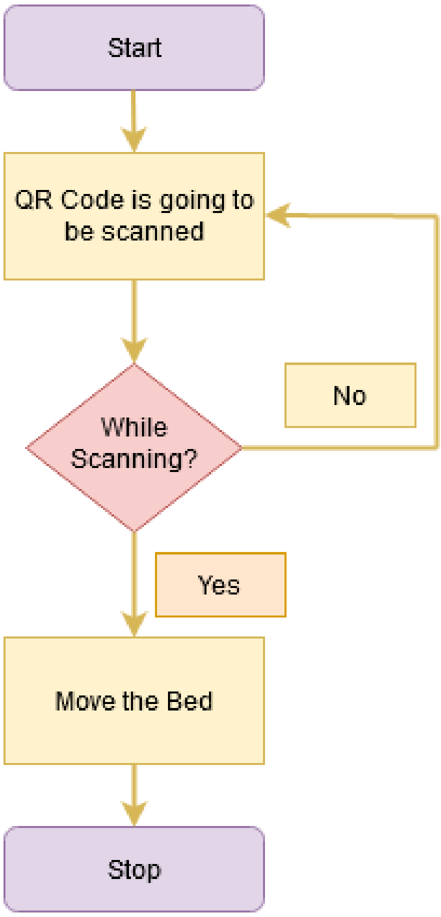

Figure 3.9: QR Code Reading

3.2.7 QR Code

Here we used some QR code such as C_11, C_12, C_21, C_22, E_1, E_2, EQ_1, EQ_2, OT_11, OT_21 and stop.

C_11 C_12 C_21

C_22 E_1 E_2

EQ_1 EQ_2 OT_11

Figure 3.10: QR Code

C_11 means Cabin number 1 and bed position 1.

C_12 means Cabin number 1 and bed position 2.

C_21 means Cabin number 2 and bed position 1.

C_22 means Cabin number 2 and bed position 2.

E_1 means Emergency position 1.

E_2 means Emergency position 2.

EQ_1 means Emergency Queue position 1.

EQ_2 means Emergency Queue position 2.

OT_11 means OT Cabin number 1 and bed position 1.

OT_21 means OT Cabin number 2 and bed position 1.

When the camera finds stop QR code the medical bed will stop moving.

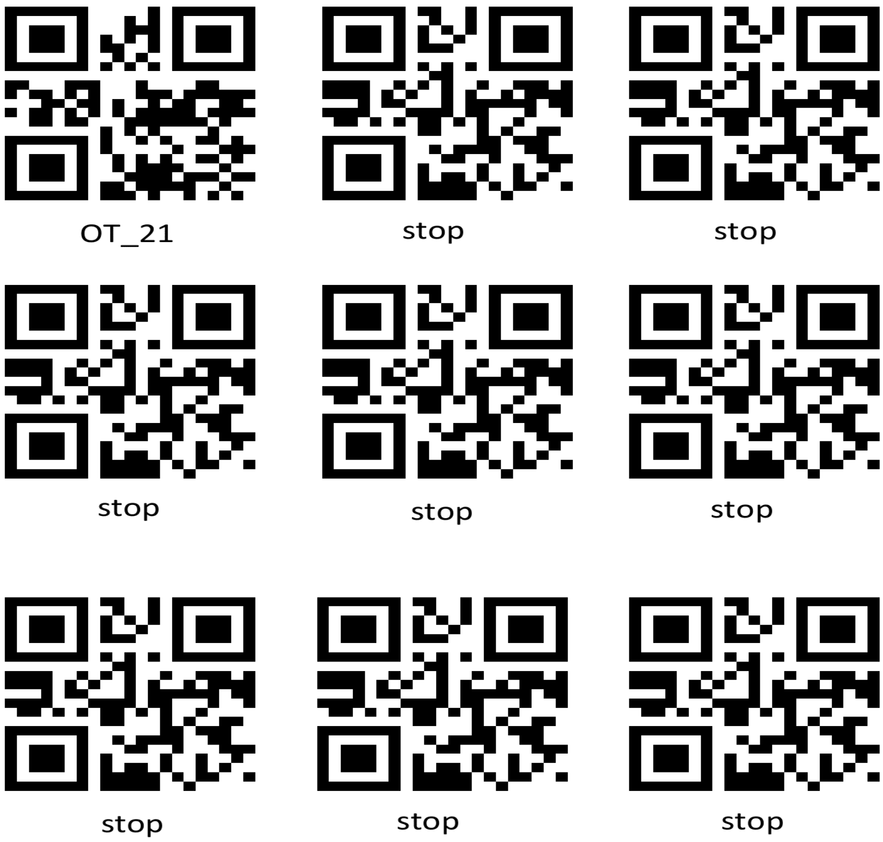

Figure 3.11: QR Code

3.2.8 Step-by-Step construction

This is the complete step our system.

Flowchart and Algorithm for move to the Cabin.

Step1: Send the signal from the Server

Step2: Bed move based on the server value

Step3: Pick the patient

Step4: Go the Cabin

Step5: Stop the medical bed

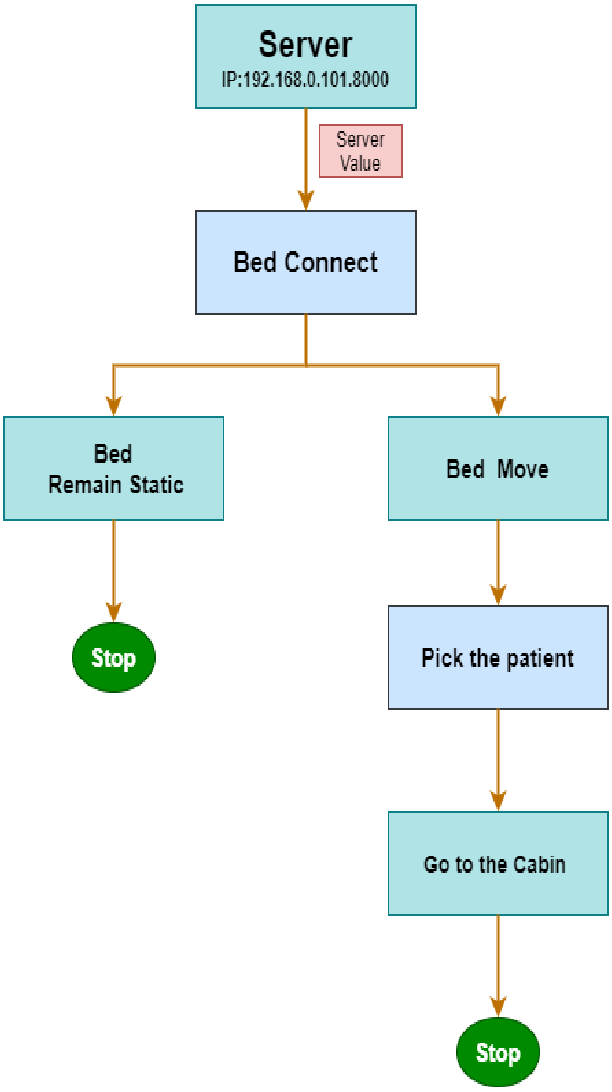

Figure 3.12: Gate Call of Medical Bed

Flowchart and Algorithm for move to the OT.

Step1: Send the signal from the Server

Step2: Bed move based on the server value

Step3: Pick the patient

Step4: Go the OT Cabin

Step5: Stop the medical bed

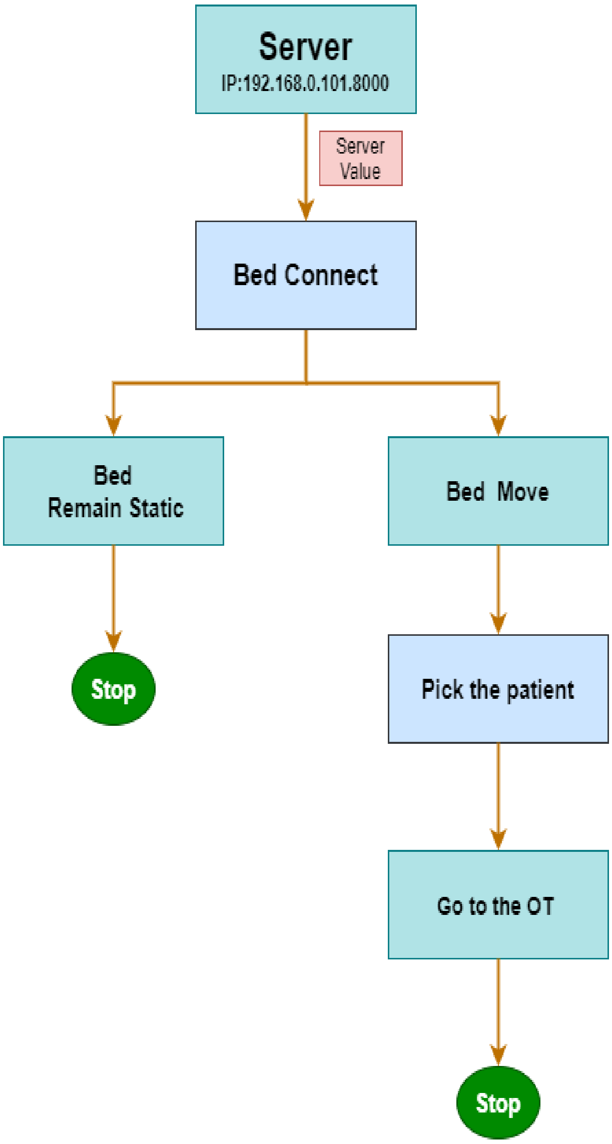

Figure 3.13: OT Call of Medical Bed

3.2.9 Bed moving Truth Table

The bed moving truth table is shown below:

Index	Gate Call	OT Call	Position leave
Stay in Cabin	0	0	0
No Move	0	0	1
No Move	0	1	0
Moving to OT	0	1	1
No Move	1	0	0
Moving to Hospital Gate	1	0	1
No Move	1	1	0
No Move	1	1	1

Table 3.1: Truth Table

Gate call 1 means that the medical bed moving to Hospital the Gate.

Gate call 0 means that the medical bed does not call from the Gate.

OT call 1 means that the medical bed moving to the OT Cabin.

OT call 0 means that the medical bed does not call from the OT.

Position leave 1 means that the medical bed moves from its position.

Position leave 0 means that the medical bed remains static.

3.3 Circuit Diagram

In the Given circuit Analog IR Sensor Array was used to read the analog value of black and white surface and 8bit ADC (MCP-3008) was used to convert the value from analog to digital. For the vision, we used a PI camera that captures the image of the QR code and streams it to Raspberry PI 3B. For the wheel rotation here used 256 RPM Gear motor. Nema-17 Stepper motor connected to the medical bed with a lead screw mechanism for moving the bed upward and downward direction. The first L298N Motor controller has connected two Gear motors. And the second L298N Motor controller is connected to the four-pin stepper controller. For the power source of the circuit here used a 12V LI-PO Battery which power up the Gear motor and the stepper motor. For Raspberry Pi power up here use a 5V 2Amp 10000mAh power bank that connects to the Raspberry pi through a micro-B USB Port. IR sensor array, Camera, ADC and Raspberry PI connect through a common 5V and GND pin.

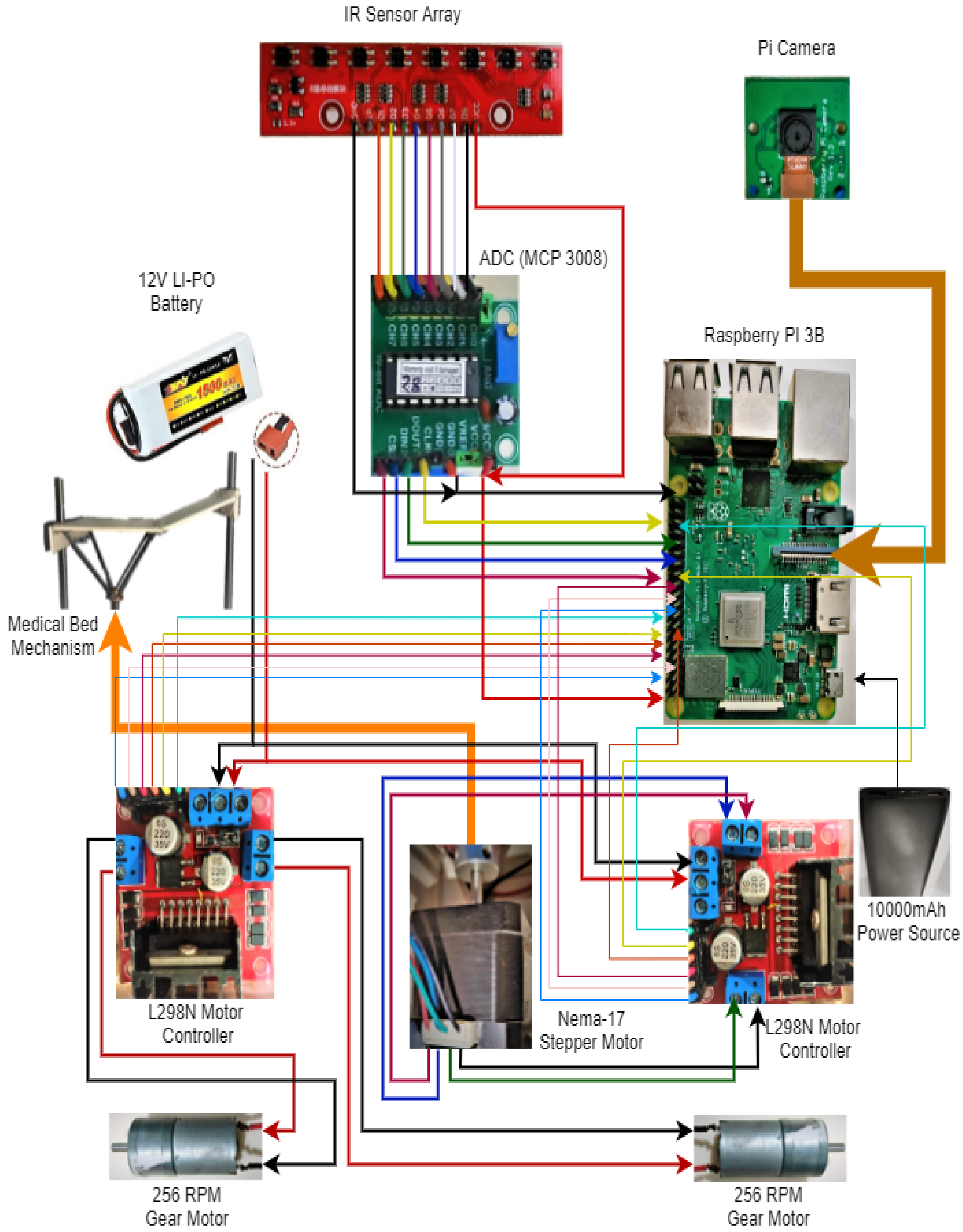

Figure 3.14: Circuit Diagram Of the Medical System

3.4 Flow Chart

This is the Flow Chart of our proposed system. Our target is to read the database using a python code that is published through a router using an IP address with port value from a server PC . We could access our database from Raspberry-Pi and now every Raspberry Pi will be defined by a unique button value and the Raspberry-Pi will move the medical bed when it faces its own button value by reading the database.

Step1: Start the Medical Bed
Step2: Read the value from the Database.
Step3: When Button = E1 && value=0?? Medical Bed move.
Step4: Read the sensor value
Step5: When all IR sensors==0?? Dealay
Step6: Then the medical bed moves and detects the QR code.
Step7: When the QR code match, then the medical bed enters the room.
Step8: Then the medical bed moves and detects the QR code.
Step9: When QR code match, then the medical bed going to its position.
Step10: Stop the Medical Bed

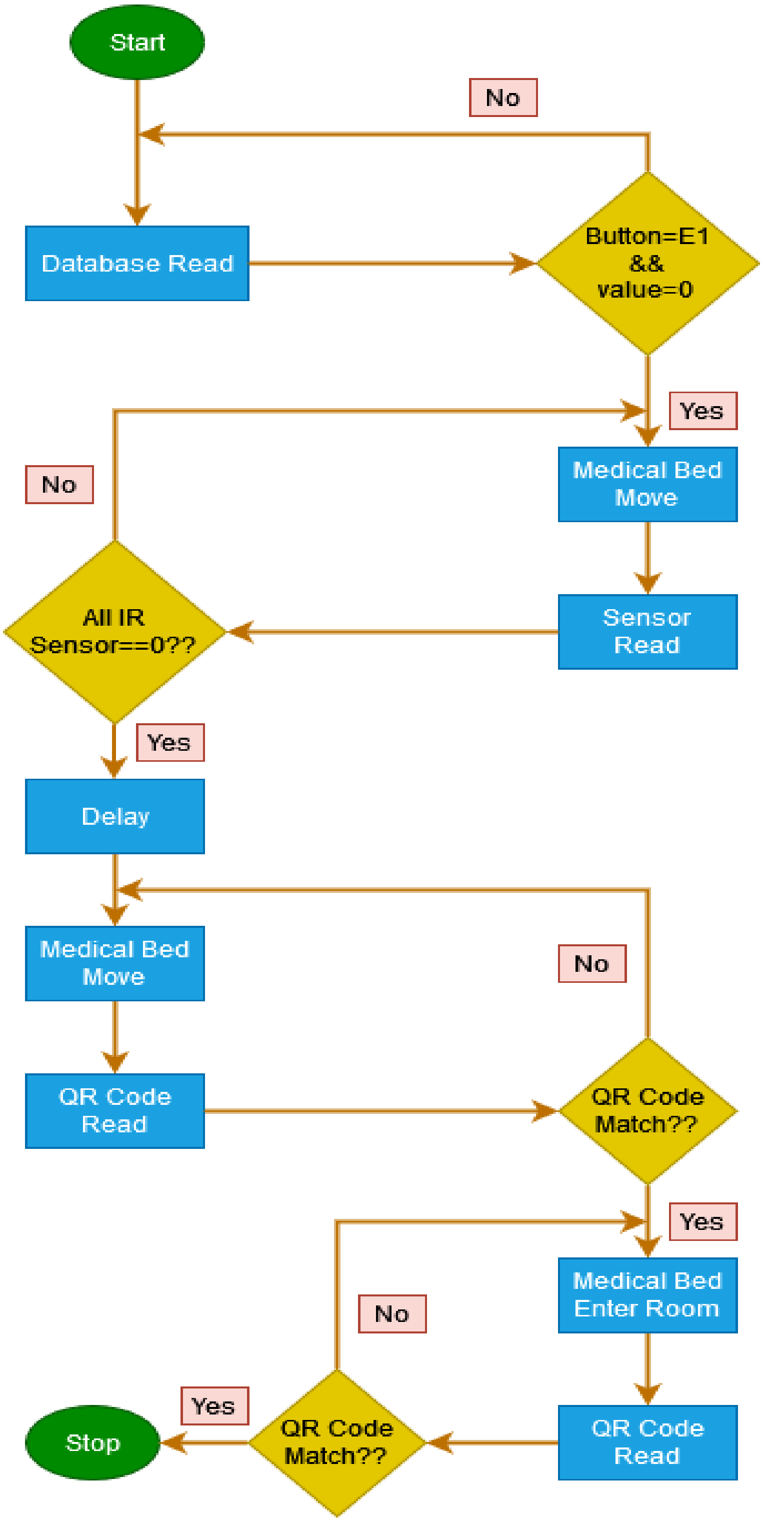

Figure 3.15: Flowchart of Medical System

3.5 Complete System Flow Chart

This is the complete system of our proposed system.

Step1: Start the Medical Bed

Step2: Read the value from the Database.

Step3: If Robot != C_12 && value!=1?

Step4: Go to step2

Step5:If Robot = C_12 && value=1?

Step6: C_12 medical bed move forward

Step7: Then the bed brake

Step8: Find the QR Code

Step9: if qrvalue!=C_12?

Step10: Go to step6

Step11: if qrvalue=C_12?

Step12: Clockwise Rotation

Step13: The bed move forward

Step14: Then the bed brake

Step15: if qrvalue!=stop?

Step16: Go to step13

Step17: if qrvalue=stop?

Step18: Then the bed move forward

Step19: Then the bed brake

Step20: Then the bed move downward

Step21: Pick the Patient

Step22: Then the bed move upward

Step23: Counter clockwise rotation

Step24: Then the bed move forward

Step25: Then the bed brake

Step26: if qrvalue!=C_12?

Step27: go to step24

Step28: if qrvalue=C_12?

Step29: Counter clockwise rotation

Step30: Then the bed move forward

Step31: Then the bed brake

Step32: Go to setp2

Step33: Stop the medical bed by keyboard interruption.

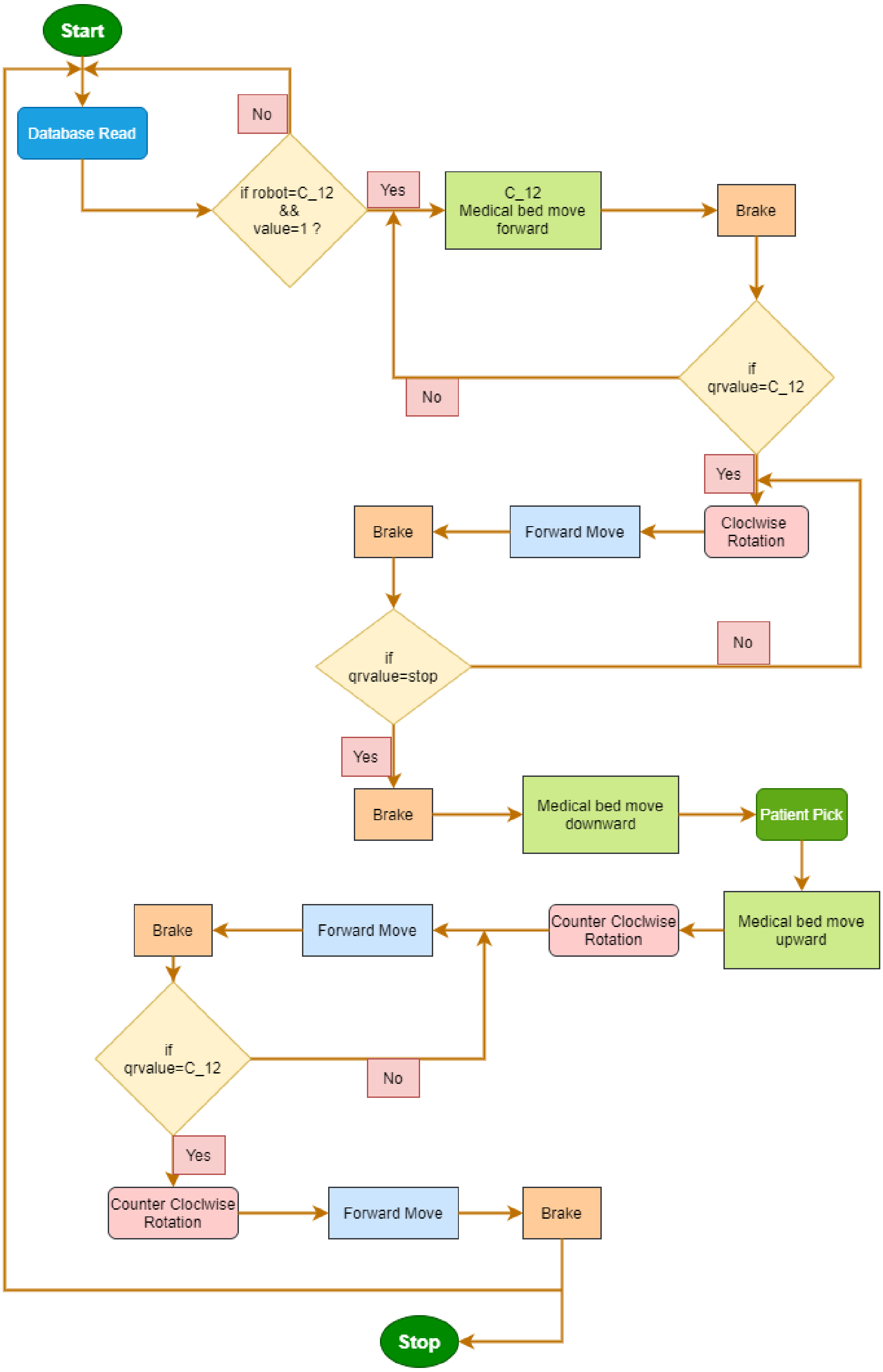

Figure 3.16: Flowchart of Medical System

3.6 Design of Medical System

We design an automatic medical system.We control the whole system using IoT technology and vision systems. Mainly we divide this project into three parts.Firstly we built a webpage for collecting all information. Secondly We designed a robotics bed which will move following a line. Thirdly Using a vision system, this bed can recognise the room by reading QR code.

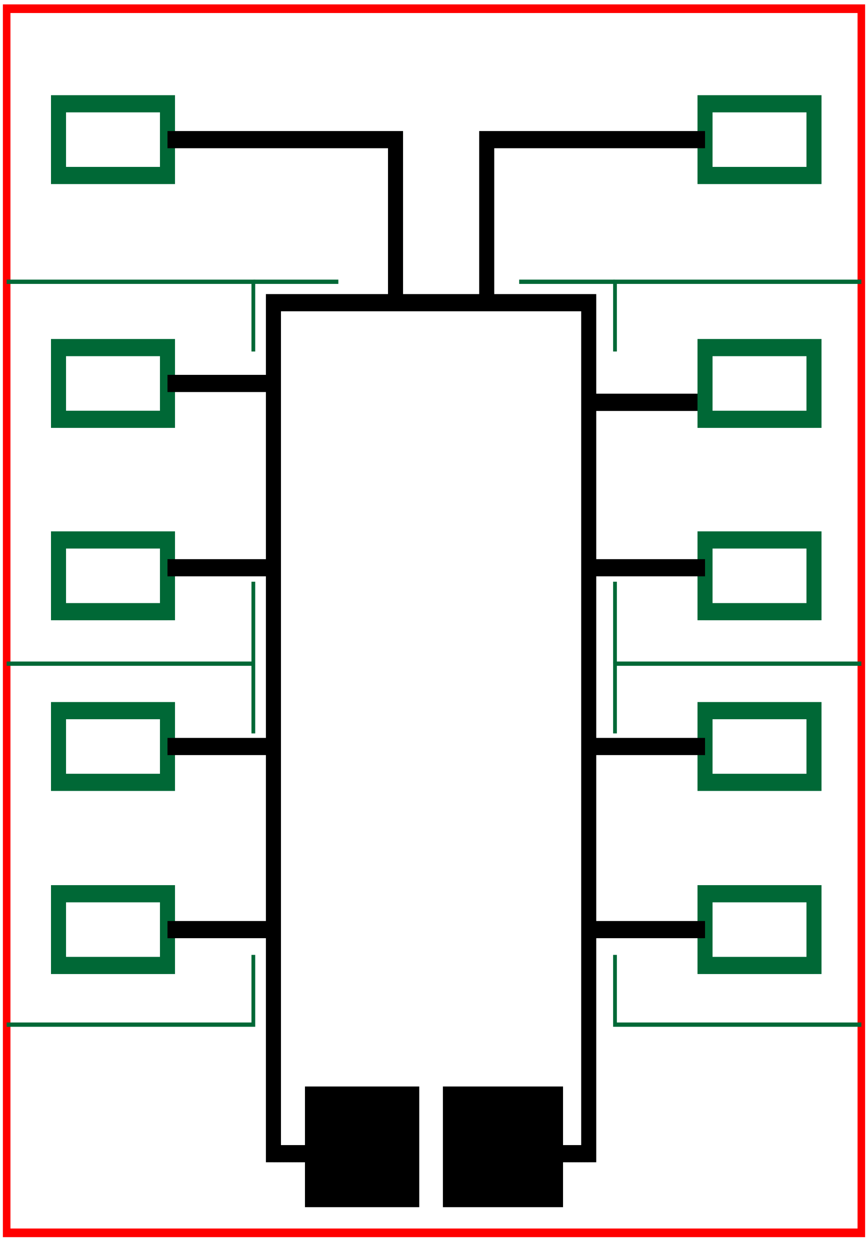

Figure 3.17: Design of medical system

This figure represents the whole system of our project. We developed a medical system using the Internet of things and vision systems. In this figure we show that when a patient comes to the emergency gate the robotics bed will receive the patient and it will go to its destination.

We made a Robotics bed for this project. We developed a line following system for a medical bed using an IR sensor.Where IR sensor reads the surface value and it will track the value of black line and move through it. The medical bed is fully automated and it is controlled by IoT.

We could control our medical bed without sensor value. Our medical bed will follow a line to read sensor value.The medical bed will detect its position to detect QR code.

But we expect to control more than one automated medical bed from a webpage. For this purpose developed an API system and also work with react.

We developed an API(Application Programming Interface). Where the API system and react are used to communicate with a hardware system and synchronize the system.

We also will develop an API(Application Programming Interface). Where the API system and react are used to communicate with a hardware system and synchronize the system.

3.7 Medical Bed

This is our Final structure of Medical Robot. It can several tasks based on the vision systems. We have a special mechanical mechanism that moves the bed upward and downward direction which describes in the mechanical mechanism section. The Robotic medical bed can be moved to any destination according to the server command.

The automated medical bed is specifically designed for patients in hospitals or others in need of medical services, and it has health comfort functionalities such as changing the position of the head and feet.

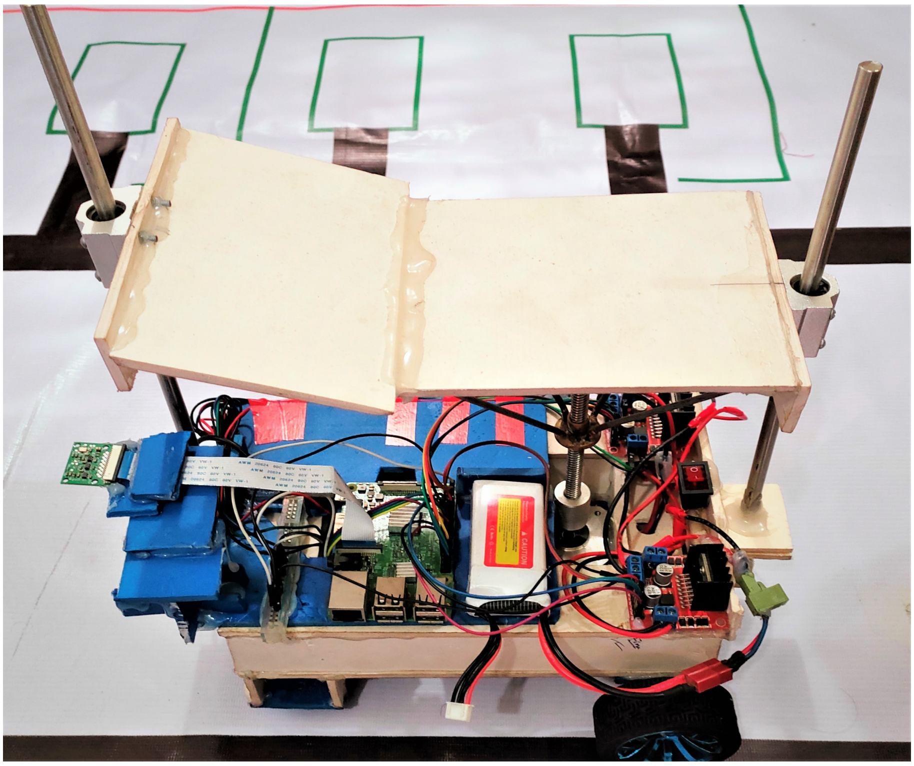

Figure 3.18: Medical Robot

3.8 Mechanical Mechanism

In this section, we described the lead screw mechanical mechanism. A lead screw connects the screw and nut when the screw is in connection with the nut to convert rotary motion into linear motion.

The medical bed moved in the upward and downward direction. NEMA-17 Stepper motor connected to the medical bed with a lead screw mechanism for moving the bed upward and downward direction.

Figure 3.19: Mechanical mechanism

Chapter 4

Methodology

Chapter 5

Result

We ran the medical bed around 14 times for moving it from cabin to gate and picking the patient and then returning it to the cabin. The result is shown below:

No of trials	Success	Failure
1st	Yes	No
2nd	Yes	No
3rd	No	Yes
4th	Yes	No
5th	Yes	No
6th	Yes	No
7th	No	Yes
8th	Yes	No
9th	Yes	No
10th	No	Yes
11th	Yes	No
12th	Yes	No
13th	No	Yes
14th	Yes	No
Total	9 times	5 times

Table 5.1: Calibration Result

Success Yes or Failure No means the bed moved to the Gate and pick the patient from the gate then returned itself to the cabin successfully.
Success No or Failure Yes means the bed missed the track of QR code and provide unwanted movement and could not be returned to the cabin.

Total number of trials = 14 times

Number of success = 9 times

Number of failures = 5 times

$$Accuracy = \frac{Number of success}{Total number of trials} \times 100\%$$

$$Accuracy = \frac{9}{14} \times 100\%$$

$$Accuracy = 64.28\%$$

$$Error\ rate = \frac{Number of failures}{Total number of trials} \times 100\%$$

$$Accuracy = \frac{5}{14} \times 100\%$$

$$Accuracy = 35.72\%$$

So, the accuracy of the proposed system is 64.28 percent.

Chapter 6

Conclusion

In this paper based on IoT technology and vision system design and control of an automated medical system.The proposed system can provide the information about the position of the bed and record the information.Smart Bed monitoring system with IoT is a system that collects information.

The ultimate device will have capabilities that the doctors know all information of patients from the control panel.

The principal thing of the suggested system's fundamental goal is to give better and more improved healthcare services to patients by constructing a networked information platform that experts and doctors may use to provide a quick and effective solution.[19]

Firstly, we used the IR sensor array but it did not complete the task that moves the cabin to gate and gate to cabin. Because the medical robot out from the track and rotate itself or moves forward to finding the track but it did not find the track for a long time and our goal can not achieve.

In our Result error is around 35% which can be minimized using the YOLO algorithm by detecting the line from the stream image of the map. Also, our error maximized due to the slip of the wheel during forwarding rotation.

In the future, we will develop the system using vision to extract the road and detect its position using YOLO algorithm.

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Appendix A: HTML Programming

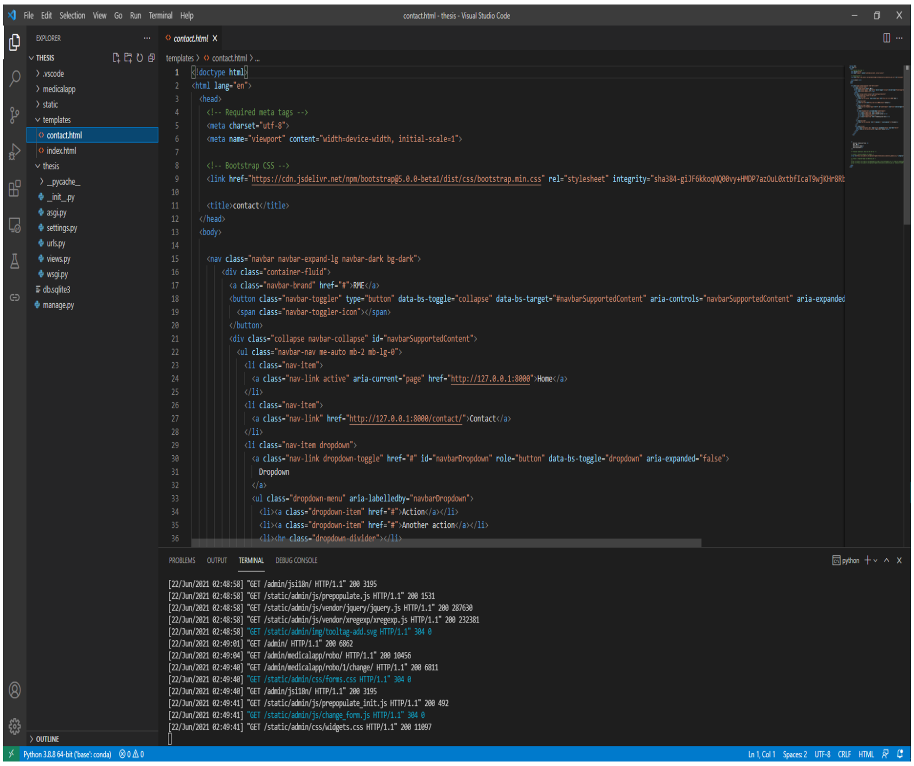

Figure 1: HTML Programming

Appendix B: Django Programming

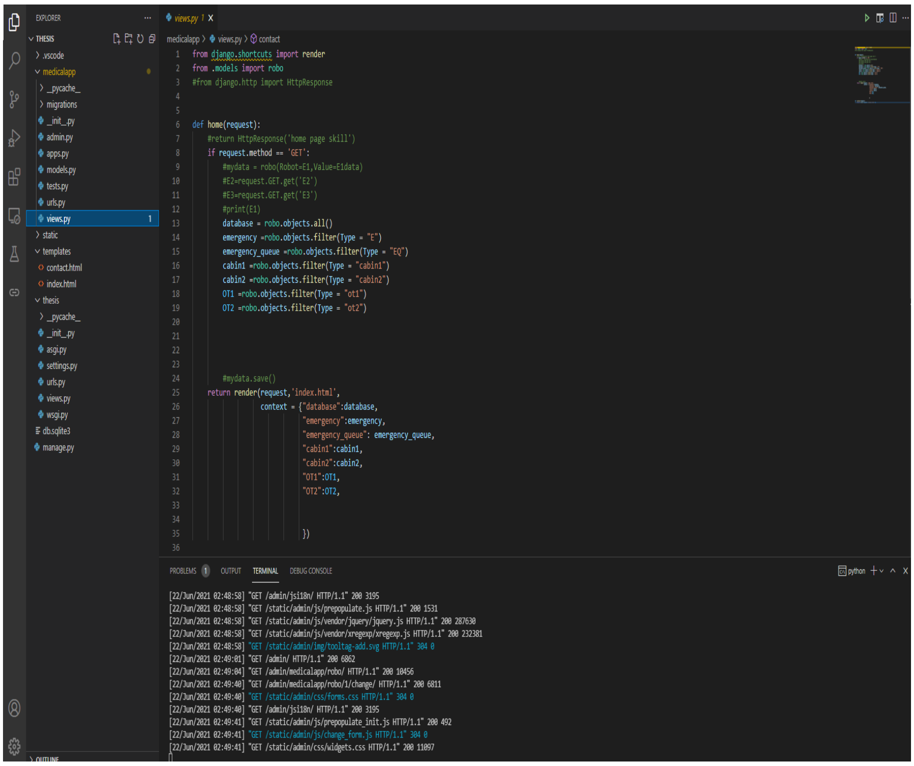

Figure 2: Django Programming