Design And Development of Fire Extinguishing Robot:
"Fireman Robot" Controlled By Android Device.

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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APPROVAL

This project titled **"Design and Development of Fire Extinguishing Robotics"**, submitted by **Mahbubul Hasan Sadek**, ID No: **151-15-4966**, to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **3rdApril, 2019**.

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We hereby declare that, this research has been done by us under the supervision of **Shaon Bhatta Shuvo, Senior Lecturer, Department of CSE** in Daffodil International University. We also declare that neither this research nor any part of this research has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Embedded system is system that is combination of Hardware and software. Robotics are also part of embedded system where hardware and software are combined to implementation of it. This project is an embedded project where I used hardware components and “An Android Bluetooth RC Car” application. “Fireman Robot” is one of fire fighter robot. This robot can detect fire and spray water and gas to extinguished fire. In modern age this robot is very essential for safe lifestyle. Fire could be occurred anytime at anywhere in our daily life, which could be very harmful for us, could be lost valuable properties. For that “Fireman robot” can help us to extinguish fire. When fire occurred any place you can remove there and could controlled fire buy using “Fireman robot”. I used this project Arduino UNO microcontroller, some sensor, buzzer and some other components and Android application by which anyone can controlled robot easily.

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CHAPTER 1

Introduction

1.1 Introduction

We are live in modern age, used so many technology and a machine. People depends on technology day by day. on the other hand technology becomes more advanced day by day .Living 21st century human can't imagine a while without technology. Among all technology 'Robot' which is most advanced technology and people becomes more interested on it.AI, Robotics, IOT, Machine learning are the main structure of future technology. For this purpose fire-fighting robot could be the alternative for humans and safety guard for the fire. Robot could be set up into the buildings for every floor, after that, when the fire occurred flame sensor will detect the exact fire by using sensor and by operating robot will go to that place and immediately will be start spray the water or gas to the fire for put off fire. Accidently, by electricity or gas problems fire could be occur that moment staying in the building everyone will be panic except that robot, for that moment for using that robot risking of human life will be reduce.

1.2 Motivation:

Recently fire occurred many place in Bangladesh, there are so many people lost their life, valuable properties are burn into fire. Although we have lots of fire services but we can't save rapidly save human life and valuable properties from fire. We have modern technology but we needs more advanced technology that can control fire in a movement. To save human life and reduce loss of properties I am inspired and motivated from recent accident of Bangladesh. That-why I build a fire fighter robot which could be used alternative of human. This robot is more advanced and effective to extinguished fire. Many of fire zone where risk for human, this robot could be used those place. This can used for home, office, industries, building and so on. Anybody can operate this robot from remote zone easily. This is an Android controlled robot, connecting robot with smart phone via Bluetooth it can be control easily.

By thinking recent fire accident and some other problems, I decide to develop a robot which could be use alternative of human and save human life and valuable properties.

1.3 Objective

- The main objective of this robot to detect Fire Location and Extinguish Fire from there .When Fire occur in any Building, Home, Flat, Apartment, Industry or so on, this Robot will Tracking Fire Location by using it's sensors and in a moment it will be reached there, spray water and gas.
- Tracking mostly dangerous fire place by using its' sensor.
- Using sensor it will send a feedback to operator about insider situation and fire temperature.
- Dangerous place could be seen by use an onboard camera with normal imaging and infrared imaging.
- This Robot can operate easily from remote zone.
- It is totally riskless and very easy to control.
- Alternative use of human.
- The most objective is Insure safety.
- Buzzer will give an alarm when Fire detect.
- Life guard and protector for property.
- Extinguish fire and reduce fire explosion

1.4 Expected Outcome

- This Robot can be control from remote using Android Device.
- Automatically detect fire and spray water or gas.
- Camera shows the internal situation.
- Required less money for this robot.
- Due to small size, it can use for home safety.
- This robot can carry very easy.
- Robot also carry water tank and gas cylinder.

1.5 Report Layout

These have shown in different chapters according to the following instruction: Chapter 2 has been given for the background of this Project. The Requirement and Design specification has been illustrated in chapter 3 where its implementation process has been demonstrated and the use case diagram has been also used. Experimental results and discussion that has been provided in chapter 4 for showing our expected outcome basis on experiment and test. Finally, we have considered some aspects through the Summary, conclusion, recommendation and implication for future research that has been also explained in chapter 5.

CHAPTER 2

Background

2.1 Instruction

In Modern technology IOT is considered as most powerful technology all over the world. In 21st century use of robotics has been developing rapidly day by day .Robotic system is system that is implement based on computer programming and combination of hardware and software. Fire fighting field, mobile system and fixed system are considered as general purpose of robotic system. Fixed system used to control for microcontroller programming, logic and suitable environment.

On the other hand to operate and perform a wide range of task mobile based System is more Future to operate .This type of robot or mobile robot system are controlled by an operator from remote zone. This robot can carry water tank or gas cylinder using wheels and truck module.

2.2 Related Works

- An android controlled "fire-fighter robot" was developed by Nevon, Which has consist of a water tank with pump, used Bluetooth module and 8051 microcontroller for this project.
- Android controlled 'fire fighter robot' project was developed by four Indian students and they used Arduino Uno R3 Microcontroller and Bluetooth Module, but they used smoker senor and motor for water spray.
- Prof . Dr .S.N KINI and his team used PIC 16F877A Microcontroller, Wi-Fi module, light sensor, fire detection sensor to develop a project named 'fire fighting robot controlled using Android Application. It worked automatically without operator.

2.3 Scope of Problem: Fireman Robot" is an embedded Project and implement on Android base. Combine of hardware and Software this project complete with some scope of problem. Like-

- This is a demo project, and implement in small size that why robot have to face some problem to implement.
- Connection of wire was complication.
- Have to setup small battery.
- Camera setup and connect with android device.
- Coding implementation.
- Air pump Motor setup and spray gas.
- Buildup robot car and controlling system.
- Setup components inside robot.
- Getting huge time to implement.
- Collection of component from different market place.

2.4 Challenges

There are some fire-fighting autonomous robot, but my project "Fireman Robot" is different of them." Fire man" is Android base Robot and controlled from remote via Bluetooth. Fire man robot can detect fire when fire occurred nearby .Fireman robot detect fire in a sort time and extinguished fire by spray water or gas. Fireman Robot can move on easily and it can turn around. Using "Android Bluetooth RC car" application robot car can control easily.

On the other hand this robot had a camera, by using camera robot Fireman Robot is able to show front things of him. When a fire is occurred inside a building Nothings cannot be seen, but Fireman robot is able to show inside situation of that building. At a time it can spray water and gas to Extinguish fire and able to make live video. Fireman robot could be a strong evidence for proof fire accident. Fireman Robot give an alarm when it detect fire and make a sound. Most interesting things about this robot is its size and its weight. Due small size and weight it can carry easily to anywhere .Motion of this robot is very fast and it can control easily from an android device by using "Android Bluetooth RC Car" application. This type of robot simulate for the real word operation to protect Human life and important property from fire. "Fireman robot "is advanced technology challenging new world.

CHAPTER 3

Requirement process Modeling

3.1 Business process Modeling

“Fireman” is an Android based Embedded or AI project and it has a business process model. Business Process Model shows how it works, how robot connect with android device how user operate the robot. This is a model relationship between user and the devices. This model implement for demand of modern technology, it is also modern expectation based project and a business process match for the Industries or Business.” Fireman” is robot which is implemented as customer satisfaction, their requirement, added modern controller and affordable tools and it is fast working robot.

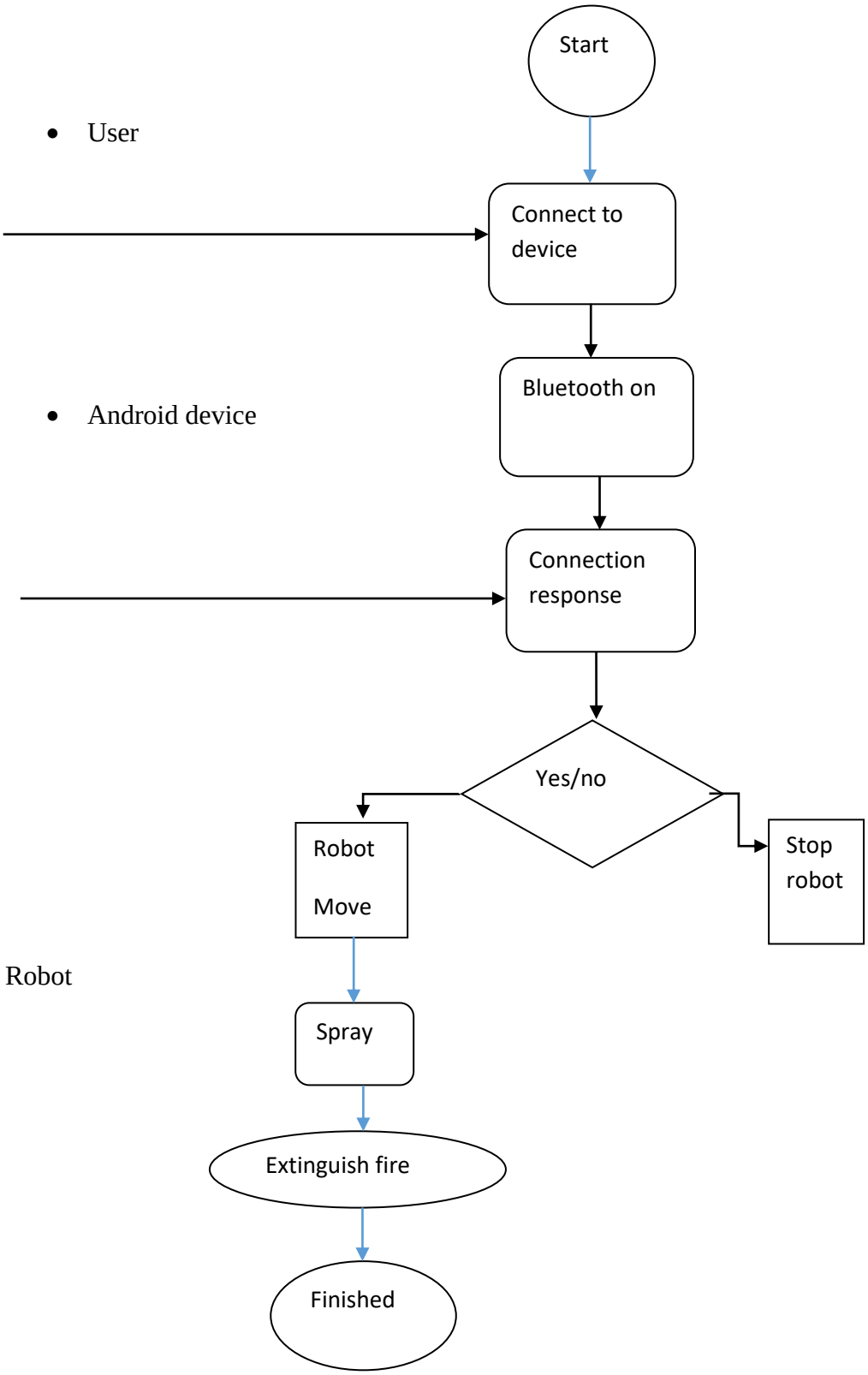

Fig 3.1: Business processing Model.

3.2 Requirement Collection

Hardware: To complete this project I used some sensors, robot casing, Microcontroller, motors, wheels, wire and some other tools. Tools descriptions are given below-

1>Arduino Motor Shield:

For this project I select L298N H-bridge IC that allows to control car speed and direction of DC motors.L298n H-bridge motor shield's Specification is given below-

Feature of L 298N H-bridge Module:

- Voltage between 5 to 35 v Dc

  For motor shield connection to Arduino there are 4 pin-

  Every motor has 2pin-

  1>OUT1

  2>OUT2

  1 pin for power and another pin for GND.
- L 298N H-bridge motor device covered 5v-35v (logical voltage)
- Logical current is between 0-36mA and derive current -2A(maximum signal bridge),and max power 25W
- Its Dimention43*43*26mm
- Weight 26g
- PWM pin 3, 5, 6, 9, 10, 11 is for Arduino UNO.

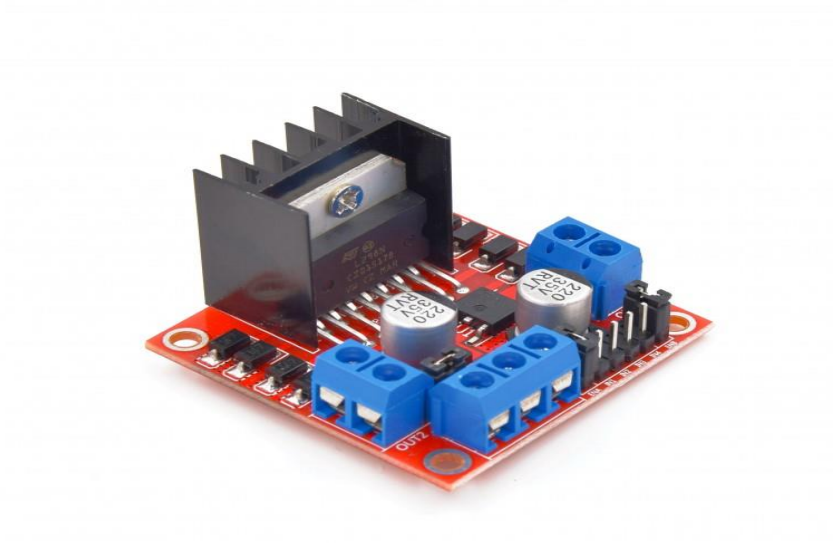

Fig 3.2: L 298N Dual H-bridge Motor Controller.

2>Flame sensor:

There are many types of sensors, among them Flamer sensor is design to detect fire and response where fire presence. Specification of Flamer sensor is given below-

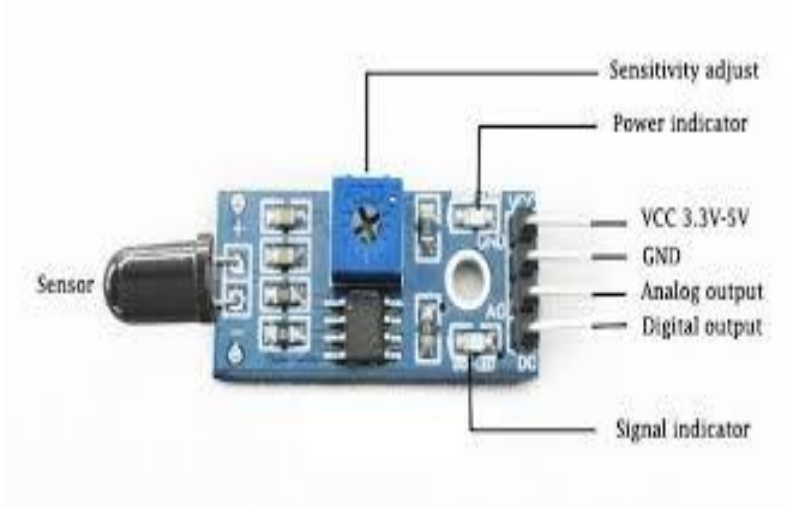

Fig 3.3: Flame Sensor Module.

Specifications:

- Power supply indicator lamp, Range of spectral Bandwidth min 760nm, typically 940nm, max 1100nm.
- Detection Angel 0-60 degree and range 0-1m.
- Power 3.3-5v.
- Operating temperature -250°~850°c.
- Dimension is 27.3mm*15.4mm.
- Mounting holes size is 2.0mm.

There is 4 pin in flame sensor-VCC, GND, AOUT, DOUT.

Working process-

- 3.3v~5.3v for VCC.
- Power supply ground for-GND
- MCU.IO (digital output) for-DOUT.
- MCU.IO (analog output) for-AOUT.

3>Gas Pump mini Motor: For this project I used CMP40 series Micro Air pump.

Features of Air pump:

Model: CMP40-2v, free flow 10L/min and its max vacuum-700mbar, max pressure 1.2 bar and current 1A and 12v DC voltage. Its temperature range is 32-122F (0-50c). Its weight 225grams, size 40*60*90mm and lit is 1000 hours and sound level 70dB (1 meter space).

Fig 3.4: CMP40 Air pump Motor.

4>Relay module and water pump:

For spray water to extinguish fire I used mini submersible pump motor. Relay module is used to control high voltage and pump used for spray water.

Specification of water Motor:

- 2.5~6v for operating voltage.
- 130~220mA for operating current.
- Water flow rate is 80~120L/H.
- Outlet outside diameter is 7.5mm and inside diameter is 5mm.
- Working life time 500 Hours.

Fig 3.5: Relay Module.

Fig 3.6: Mini water pump.

5>Buzzer:

Buzzer is very interesting device for give an alarm. Buzzer used on"Fireman robot" combine with Flamer sensor so that when fire detected Buzzer give an alarm making a sound like-beeeepp. When water level Decrease in low level…buzzer also give a signal.

Fig 3.7: Buzzer.

6>Bluetooth Module:

"Fireman robot" Connect with an Android Device by using a Bluetooth module named HC-05 Bluetooth Module." Fireman" could be controlled from remote by this Bluetooth module.

Specification of HC-05 Bluetooth Module:

Table 3.1: Specification of HC-05**.**

item	features
Bluetooth Protocol	Bluetooth specification v2.0+EDR
Frequency	2.4GHZ ISM band
Modulation	GFSK
Dimension	29.9mm*13mm*2.2mm
Working temperature	-20~+75centigrate
power	+3.3v DC 50mA
Emission power	4dBm,class2
Sensitivity	<=-84dBm at 0.1% BER
speed	2.1Mbps(max)/160Kpbs,synchronous:1mbps/1mbps
Applications	Computer and peripheral device, GPS receiver, Industrial control, MCU project.

Fig 3.8: HC-05 Bluetooth module.

7>Arduino Microcontroller:

Arduino is open source Electronics platform where user can use hardware and software easily for various project. For this project I used Arduino UNO microcontroller, UNO Rev3 is a ATmega328p microcontroller board base, an 8 bit microcontroller with 32kb flash memory and 2kb RAM, UNO supports controller and it is easy to connect with computer USB cable.

Specifications:

- Arduino UNO is open source for hardware and software.
- Adriano has both Digital and analogue pins.
- Microcontroller is AT mega 328.
- Operates voltage 5v.
- Its input voltage (recommend) 7-12 v and input voltage (limit) 6-20v .

Arduino Uno has various pins for specific task .like-

GND- GND full form is ‘ground’.

PIN4 & PIN 5- PIN 4 use to supply 5 voltage and PIN 5 use to supply 3.3v.

PIN6-PIN 6 used to read analog signal from sensor and convert to a digital value.
PIN7-PIN 7 is used for both digital input and digital output.
PIN8- PIN 8 is (PWM) called pulse-width Modulation

On the other hand ARDUINO UNO Dc current per I/O pin 40mA, DC current for 3.3v 50mA and its flash memory is 32kb,SRAM 2kb, EEPROM 1 kb and clock speed-16MHZ. Arduino UNO has also reset Button ,and power Led indicator, TX RX led an so on.

Fig 3.9: Adriano UNO Microcontroller.

8> Required other Hardware Tools

To complete “Fireman robot” project, we need some Hardware Components -

- Soldering Iron.
- Glue Gun.
- Jumper Wire.
- Motors(water and gas)
- Camera.
- Resistors.
- Led.
- Buzzer.
- Battery.

- Pipe(for water and gas spray)
- Water container.
- Gas cylinder.
- Wheels.
- Robotic toy.
- Chasses.

Fig 3.10: Hardware Component.

Software

- ‘Fireman robot ‘needs to operate to control and to operate from remote an Android device needed.
- Operate Fireman robot needs “robot controlling Android Application“ ” Bluetooth RC controller” is available on Google play store and I used this Application for my Project.

Fig 3.11: Arduino Bluetooth control car Android Application.

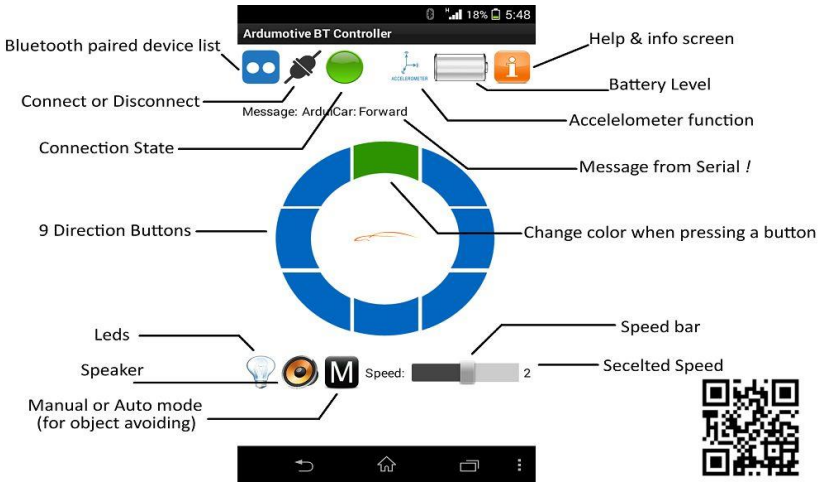

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Fig 3.12: Application control system.

3.3 : Use Case Diagram

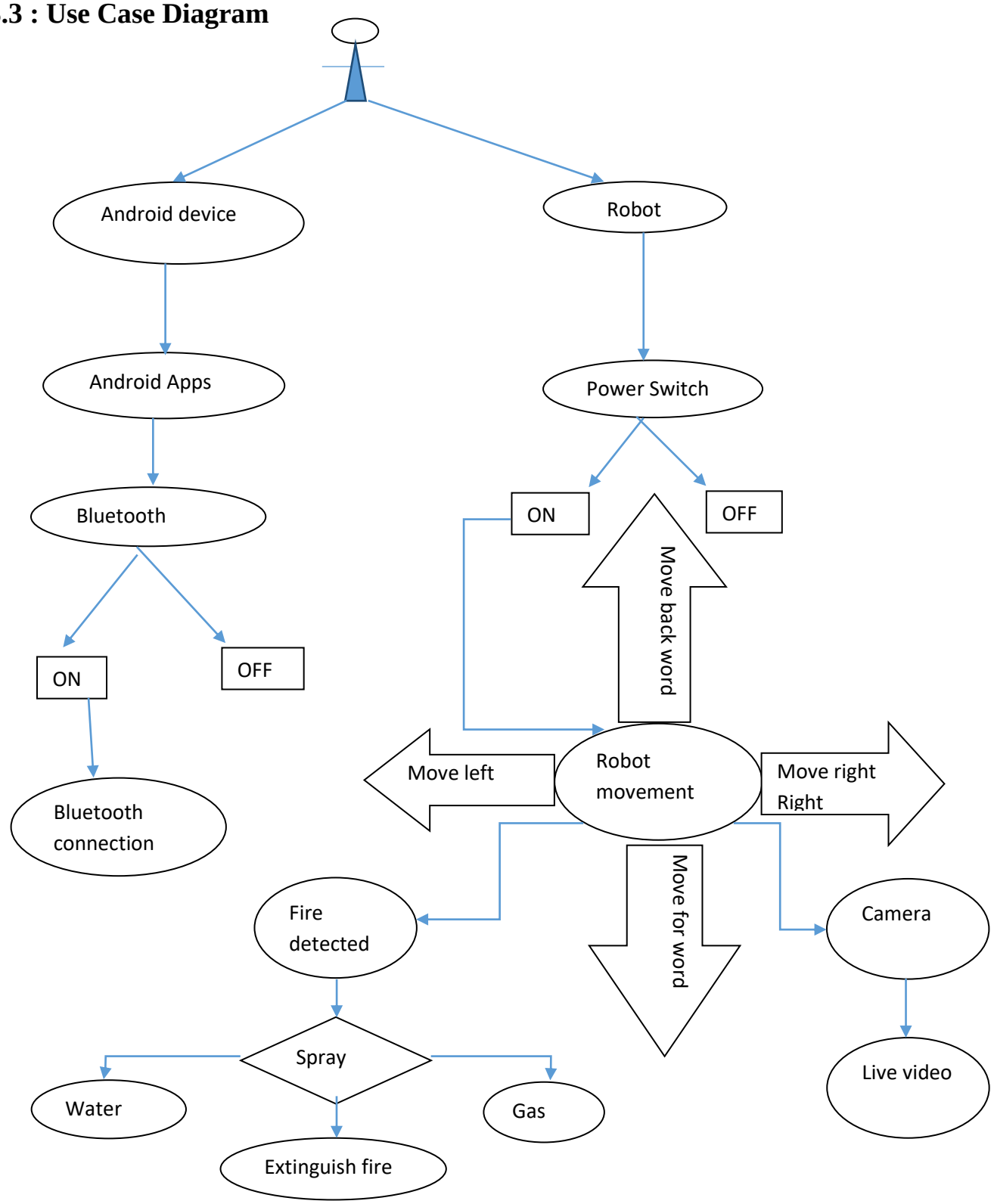

Fig 3.13: Use case diagram.

3.4 Design Requirements

- A plastic Robotic toy used for Robots Structure.
- Fireman Robot setup on a robotic car attached motors with for wheels for motion.
- A Bluetooth control camera added on eye of robot to records video.
- Two hands of robot used for spray, one hand spray water and another hand spray gas.
- Different parts of robot required different voltage-like as, motor driver used 4-6v, Arduino and some sensors used 7-9v, water and gas pump motor used 12v battery.
- A bread board used for various Connection.
- Water tank And Gas cylinder used to store liquid.
- Control robot and program for robot an Arduino UNO Microcontroller used for this project.
- Some other tools or equipment are connect with Arduino UNO Microcontroller, like - Flamer sensor, Bluetooth Module, camera, some resistors ,Led, and jumper wires.

3.5 Interaction Design and UX

Interaction Design concern with the process of creating products which provide meaningful and relevant experiences to user. Including aspects of branding, design, usability and function and integrating the products to user is main purpose of UX. Behavior , motion, sounds, space time and so on which are full-fill requirements for user to project connection.

3.6 Implementation requirements

- A computer or laptop for programming.
- Bluetooth Module to create connection between Arduino device and robot.
- A Flamer sensor.
- Arduino IDE for coding part.
- Arduino UNO Microcontroller with USB cable.
- Jumper Wire.
- Battery in Different voltage.
- Buzzer.
- Relay.
- LEDs.

- Two motor-Water and gas .
- Android device.
- Water tank and gas cylinder.
- Pipe- for water and Gas spray.

Fig 3.14: Arduino IDE.

CHAPTER 4

Test and implementation

4.1 Robot design And implement

Every project had a implementation design, that show how to setup projects parts. “Fireman robot” project first design on a board, then it set up inside a Toy Robot that give a standard shape. After then "Fireman” setup on a robotic car for its movement and control by an Android device from remote. Fireman robots implementation design are shown below-

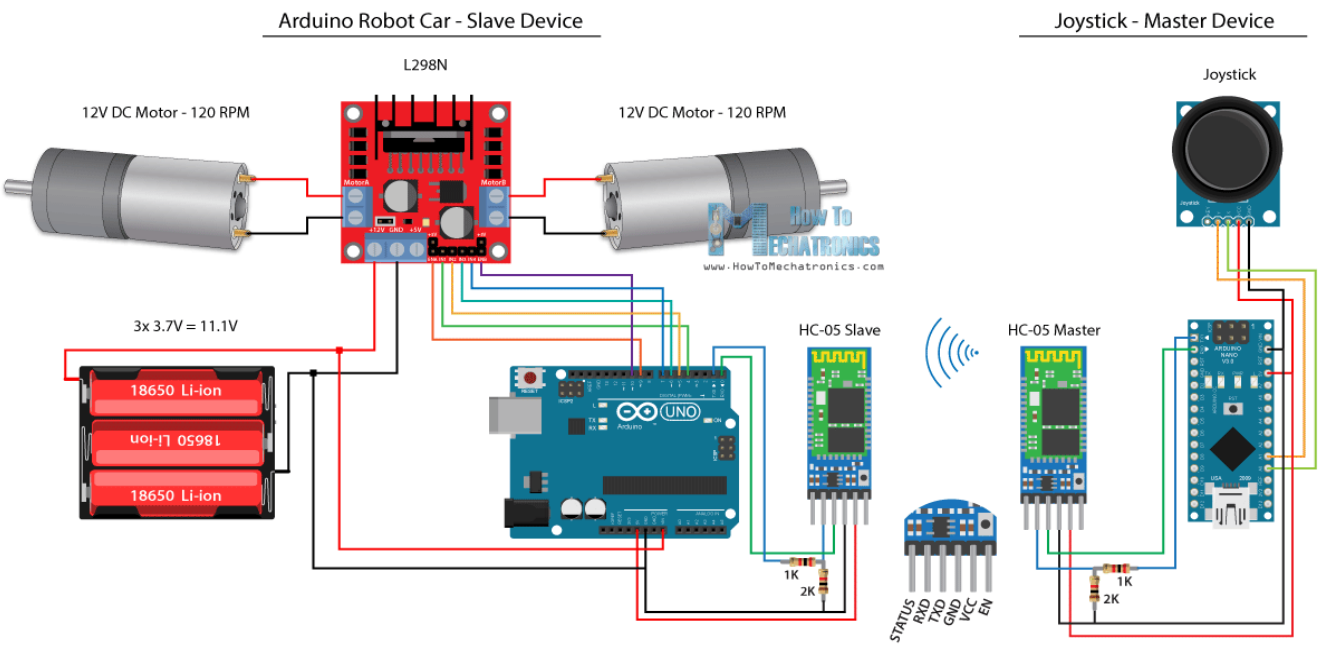

Fig 4.1: Implementation design of Robot car.

4.2 Testing Robot

Overview: After implementation of 'Fireman Robot' it is very important to test on safe zone. However Fireman robot looks like as picture below-

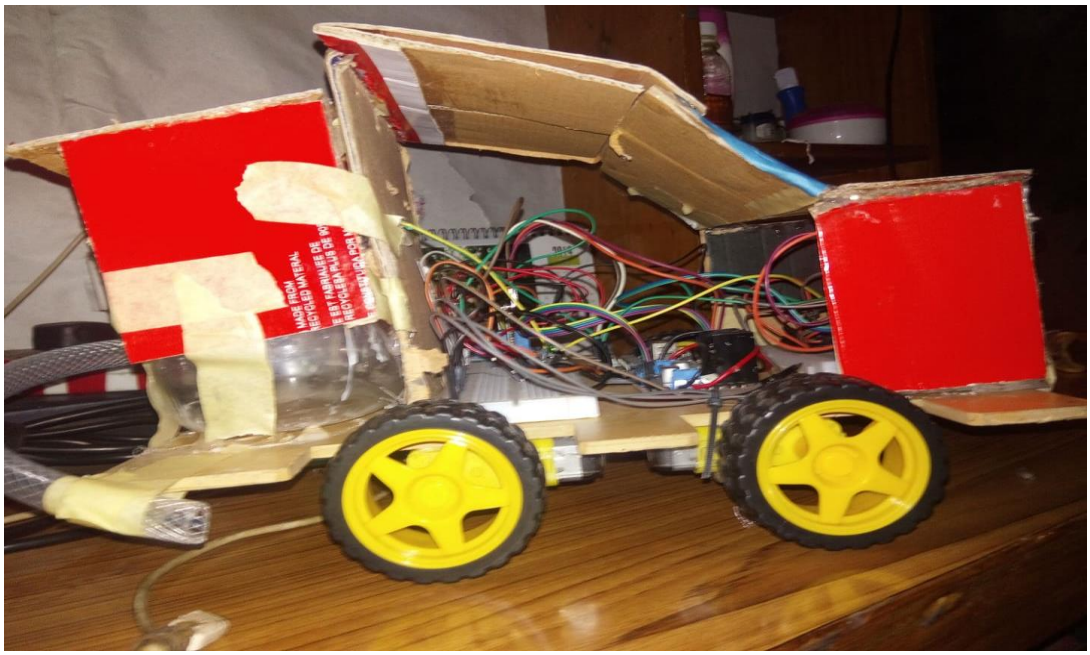

Fig 4.2: Fireman Robot Overview.

Different Parts of Fireman Robot is response for different task. Those task are given below-

EYE: Eye of Fire man Robot works like Human Eye. Eye of this robot make a live video, which could be seen from Android device.

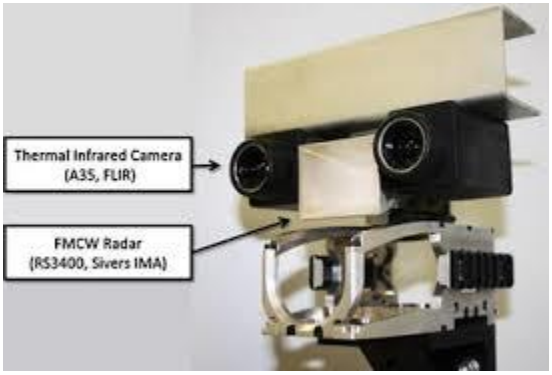

Fig 4.3: Eye of Fireman Robot.

Hands:" Fireman Robot" has two hands which is responsible for spray water and Gas. When fire detect fireman will be go there and spray water by its hand. If the water level getting low, it will be spray gas. Another things is when water level getting low, operator could be add water pipe directly for water spray.

Fig 4.4: Robots Hand, spray water and gas.

Car: Main purpose of this project is to detect fire and extinguish fire and give a feedback via live camera. That's why this robot not implementation for walking and therefore it setup on a car for its movement. This robot can move easily and could be control it motion by using car from an android device.

Fig 4.5: Robots Movement using car.

Hardware Implementation:

Fireman Robot is developed with various hardware components .Implementation of every parts of robot I have to coding for different components. like as-For Arduino Micro controller needs to coding for its pin mode, for pump water and gas have to implemented some code, for flamer sensor to detect fire have to implemented coding, for car movement and controlling and making live video via camera ,and its setup have to coding individually. However all components coding was done using Arduino IDE.

Software Implementation:

Software implementation needs to connect robot with android device and control car .After coding implementation by Android IDE that is uploaded to Microcontroller .Successful implementation of coding part an Android Application have to install on Android device(mobile phone/tab). “Arduino Bluetooth RC car” Application is available o Google play store. However after installation application turn on Bluetooth of the device and search for Bluetooth module. After then connect to Bluetooth module which is implemented on robot named HC-05 Module. When Robot connected to Android device it will be worked properly. Combination of hardware and software this project will run successful and would be able to detect fire and extinguish fire.

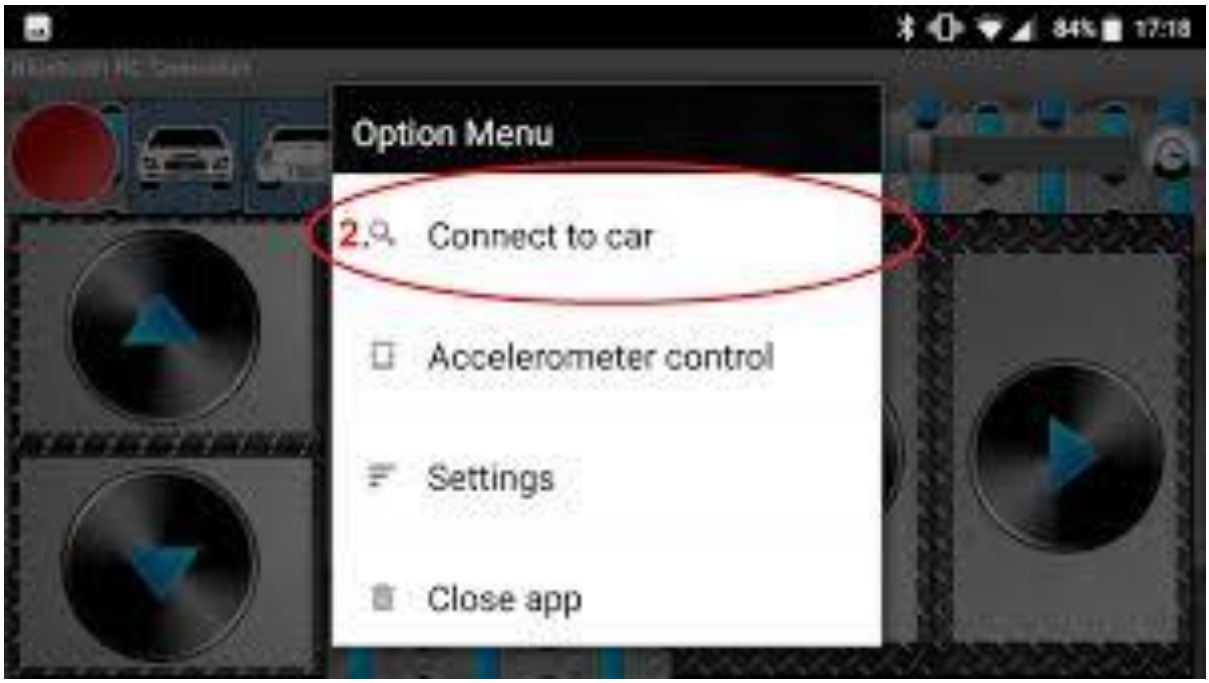

Fig 4.6: Arduino Bluetooth RC Car Application and connection interface.

4.3Limitations:

- "Fireman Robot "cannot work under water or on Air.
- Without Android device it can't control from remote zone.
- Battery power is limited, when battery charge is over it will be shut down.
- Sensor life is short, if the Power Cross over the limit, sensor will be destroy.
- This robot can use for only extinguished fire.
- When power of robot is on, then it will be worked, otherwise it can't worked self.
- An operator needs to operate Robot.

CHAPTER 5

Conclusion and Future Scope

5.1 Conclusion

There are many types of Robot.AI robots are tree types-General AI, Intermediate AI, Advanced AI. My project-‘Fireman Robot” is general types robot, even most of fire-fighting robot are general types of robot where used for developed, embedded c etc. Now–a-days robotics becomes popular rapidly. People are become more depend on robots. Fire fighter robot like fireman robot could be used fire place alternative of human, that’s help to save life and valuable properties.

I have successfully build “Fireman Robot” which is an Android controlled robot .this type of robot could be implement with little amount of money and its components are available. This type of robot could help people and in future it could be more advanced. Arduino UNO used for this project, when raspberry pi or more advanced microcontroller will be used robot could be build more advanced and effective. Implement a robot a developer needs to giving full afford, have to hard work .Finally it can be say that, Fire fighter robot like “Fireman Robot” is very essential robot to extinguish fire. Recently fire occurred so many place in Bangladesh, lots of people died because of fire.” Fireman Robot “could help to extinguished fire.

Robot Behavior

Purpose of this project extinguished fire by using a robot that can use alternative of human. This robot can turn around and can spray water and gas. At the same time it can make live video by using its camera. Like other robot it has some common behavior, like-making sound, turn on Led etc. This type of robot is very useful for country and human.” Fireman Robot” added a new theme in modern technology.

5.2 Future Scope for Development

- In future this robot will be implemented with more advanced components-like sensor, led, buzzer etc.
- For future this robots connection will be implemented by Wifi module for more facilities.
- Raspberry pi will be used alternative of Arduino UNO.
- Some sensor will be added, like-smoker sensor, ultrasonic sensor, etc.
- For home and personal use it will be implemented in low cost.
- This robot will be implemented a Drone for more advanced facility.
- Robots body will be more modified and would be fire resistance.

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