

Android Controlled Firefighting Robot using Arduino

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Abstract - Nowadays, fire accidents are very common and sometimes it becomes very hard for a fireman to protect someone's life. It is not possible to appoint a person to continuously observe weather accidental fire has started where robot can do that. Robot will detect fire remotely. These robots are mostly useful in industries. The proposed vehicle is able to detect presence of fire and extinguishing it automatically by using temperature sensor. The proposed robot has a water spray which is capable of sprinkling water in 180° angle. The sprinkler can be move towards the required direction. At the time of moving towards the source of fire it may happen that it will come across some obstacles, then it has obstacle avoiding capability. It detects obstacles using ultrasonic sensors. Communication between the mobile phone and robot will take place through Bluetooth, which will have GUI to control the movement of robot. When mobile gets connected to Bluetooth firstly it will set module name, baud rate. It is feasible to implement Bluetooth communication between smartphones and micro-controller. Android controlled robot can be used easily in everyday life such as in homes, market, companies etc. The development of apps for Android in Android SDK is easy and free of cost.

Key Words: SDK, TFLC, OAFLC, LM35, Arduino UNO R3 etc

1. INTRODUCTION

Now a days mobile robots are very useful in construction sites, warehouses and manufacturing plants. Mobile robots can also be used in material handling applications which applications are growing day by day. For analyzing different items and for handling materials mobile robots can be used. Wireless navigation is also possible for movements of mobile robot, can be controlled through android. Fuzzy logic control mechanism is used to control robot. That model does not need any mathematical model controlling. Previously Fire Fighting Robots were controlled by using different electronics devices. But this reduces the scope of control of fire fighting robot. However, with the advanced techniques we can build the same robot by using android application to control the actions of the robot. With the help of such robots, fireman's work really decreased and movements of robot are so much effective. By using an android app fireman can detect the fire and can able to extinguish it. At the same time robot can detect the obstacles and can avoid them by using ultrasonic sensors. Our project is designed to build an android application which can control operations of the fire fighting robot. Fireman can send commands to robot through Bluetooth module which is mounted on robot itself. Smart phones has facility of Bluetooth, through that

Bluetooth fireman can control the movement of firefighting robot. For fire detection it is using two sensors. One is temperature sensor and second is smoke detector. Fire extinguishing system will be get activated when fire detection system detects fire. Sprinkler will start sprinkling water when it detects fire. At the transmitting end android application is used and at receiving end two motors are interface to micro-controller.

2. LITERATURE SURVEY

Tawfiqur Rakib, M. A. Rashid Sarkar Proposed movable robot consists of sensor like LM35 and Arduino Flame Sensors are used to detect the fire and distances on its way towards fire. In this for the mobility of the Robot, two wheels made of Nylon and a caster ball is used. This is mainly a rear wheel drive type of vehicle. The water container has the capacity to contain at least 1L water. It is made of strong cardboard which has water resistant property. [1] A fuzzy controller is used to control an obstacle avoidance of Vehicle. The aim of the proposed solution which is given in the paper is to guide the Vehicle along its path to avoid any static environments containing some static obstacles in front of it. Obstacle avoidance in real-time is a mandatory feature for Vehicle in an unknown environment. [2]

Shivam Agrawal, Nidhi Agrawal proposed that the human can control the robot by using the Bluetooth module. The Bluetooth module is work with the android application. In this the Bluetooth model communicate android application by using driving motor, arduino mega, voltage divider, tyres, Bluetooth, motor driver. [3] Saravanan P., Soni Ishawarya stated that there are three different types of system unit is use

1. Locomotion system
2. Fire detection system
3. Extinguishing system
4. Communication system.

The Locomotion system is used for obstacle detection and four ultrasonic range finder to find the distance between obstacle and system. Fire detection system is used for the detection of fire in this the gas sensor is used. Extinguishing system is for successfully extinguish the fire. [4]

S. Jakthi Priyanka, R. Sangeetha proposed that Arduino (UNO R3), gas sensor, motor driver, gear motor, Relay driver, Bluetooth module, pump and sprinkler are

used. To program Arduino UNO R3 open source software Arduino IDE is required. The detection and extinguishing was done with the help of Arduino in which the temperature sensor gear motor and its driver, relay driver etc. are interfaced. The "Android controlled firefighting robot" is useful in everyday life such as in homes, laboratories, parking lots, supermarkets, companies, stores, shops etc. Important function of the robot is patrolling. Limitation of the robot is Bluetooth range and water capacity.[5]

The system controls four DC Geared motors which is powered by the tmega2560 and controlled autonomously by Navigation system which comprises of integrated ultrasonic and infra red sensors. The bot carried wireless camera with it which captures the video and transmits it to the base station. The fire detection system consists of LDR and temperature sensor. If fire is detected there then the bot will be moved to the source and starts extinguishing it. The Extinguishing System mounted by BLDC motor with water container. At extreme conditions SABOT is manually operated also. [7]

3 Methodology

Proposed project is designed to build an android application which can control operations of the fire fighting robot. Fireman can send commands to robot through Bluetooth module which is mounted on robot itself. Smart phones has facility of Bluetooth, through that Bluetooth fireman can control the movement of firefighting robot. For fire detection it is using two sensors. One is temperature sensor and second is smoke detector. Fire extinguishing system will be get activated when fire detection system detects fire. Sprinkler will start sprinkling water when it detects fire. At the transmitting end android application is used and at receiving end two motors are interface to micro-controller. There are two types of robot navigation in environment by using FLC.

Tracking Fuzzy Logic Controller (TFLC)

Obstacles Avoiding Fuzzy Logic Controller (OAFLC)

Following flow diagram can give the clear idea about the flow of TFLC and OAFLC.[7]

TFLC is used to move robot in any direction according to the commands sent by the fireman. As soon as obstacle is detected control transfers to the OAFLC to avoid obstacles.

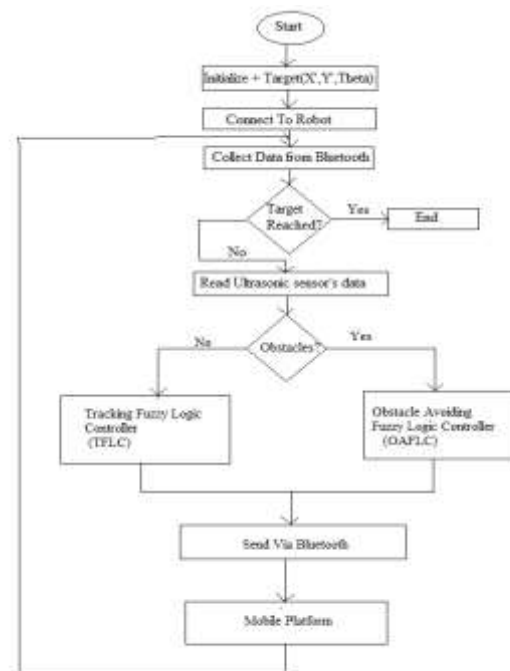


Fig -1:Flowchart of Fuzzy Logic

To travel robot towards the target TLFC and OAFLC these two FLC methods are useful because it assures the collision free path. Output of these two techniques will be velocities of left and right DC motors. TFLC moves robot smoothly towards the target and for that purpose TFLC will required two inputs. One is distance between obstacle and robot, and another one is angle between robot and obstacle. The variables used for the angle between the robot and the obstacle to show in implementation table are: N: Negative, SN: Small Negative, Z: Zero, SP: Small Positive and P: Positive. The linguistic variables used for input distance are: Z: Zero, NZ: Near Zero, M: Medium, NF: Near Far, and VF: Very Far.[7]

Angle \ Dist.	P	SP	M	SN	N
Z	LM ^z	LM ^z	LM ^h	LM ^{vh}	LM ^h
	RM ^h	RM ^{vh}	RM ^z	RM ^z	RM ^z
NZ	LM ^s	LM ^z	LM ^{vh}	LM ^{vh}	LM ^{vh}
	RM ^{vh}	RM ^h	RM ^z	RM ^z	RM ^s
M	LM ^m	LM ^s	LM ^s	LM ^h	LM ^m
	RM ^{vh}	RM ^{vh}	RM ^s	RM ^s	RM ^m
NF	LM ^m	LM ^s	LM ^s	LM ^s	LM ^m
	RM ^m	RM ^s	RM ^s	RM ^s	RM ^m
F	LM ^h	LM ^h	LM ^m	LM ^h	LM ^h
	RM ^h	RM ^h	RM ^m	RM ^h	RM ^h

Fig -2: Table For implementation[7]

The above table shows the implementation of the FLC in real life scenario. Implementation is to be done with the help of

above table. OAFLC is normally used to control signals and to avoid obstacles which may come along the path towards the target. For avoiding those obstacles OAFLC will required distance and angle between robot and obstacle. Ultrasonic sensors can

provide that distance .Following table shows the use of fuzzy logic algorithm. The variables used for the TFLC fuzzy rule to show in implementation table are: Z: Zero, S:Slow, NM: Near Medium, M: Medium, NH: Near High, H: High and VH: Very High.[7]

3.1 Algorithm For Obstacle Avoidance

For obstacle detection ultra sonic sensors are used. Ultra sonic sensors constantly emits the signals which has short and high frequency. If any object is present inside the path then frequency will come back to ultra sonic sensor which is consider as an input through echo pin which is on sensor. Firstly make the echo and trigger pin low and move the robot in forward direction by default. When obstacle is detected the echo pin will be set to high and start timing. Timing will be stop when the echo pin will be down and it will return timing pulses .From those pulses time will be calculated. That time will get converted into distance. If distance is moderate then speed of the robot will be reduced and robot will take left turn. If obstacle is at left then it will take right turn. If distance is very less then robot will get stop ,move in backward direction and will take left or right direction.

3.2 Operational Details

A) MODULES :

Fire Detection: Temperature sensor IC is available to simplify broadest range of temperature. A temperature sensor IC can operate over the nominal IC temperature range of -55C to +150C. Temperature sensor continuously measures temperature. If temperature exceeds the programmed limit then messaged will be displayed that fire is detected . Temperature sensor has three pins one is for GND, second one is for VCC and last one is OUTPUT which requires maximum 5.5v power supply. Temperature sensor is directly connected to Arduino.[19] Fig. 3. Temperature Sensor

Fire Extinguisher: For extinguishing fire first of all we need to detect fire. Fire is detected using temperature sensors and command goes to servo motor and relay motor to start. Relay motor is used to flow water through pump and servo motor is used to rotate pump in 180 degree directions. Servo motor starts flowing water in 180 degree through pump.

Obstacle Avoidance: Ultra sonic sensor, HC-SR04 emits an ultrasound which travels through air. If there any obstacle is present in the path of its rage then it echo it back to the

sender. Then programmer can easily find out distance between obstacle and robot using time required to travel and speed of the sound. It will be helpful for robot to avoid obstacle . Ultrasonic module has 4 pins GND, Trig, VCC, and Echo. The GND and VCC pins of sensor needs to be connected to the GND and 5V of pins on Arduino board and Trig and Echo pins are connected to any Digital pins of Arduino board.[17] Obstacle avoidance is done by using ultra sonic sensor. Ultra sonic sensor gives distance between obstacle and robot, using which obstacle can be avoided. Fire can move robot in any direction , when obstacle is detected robot will stop and move in backward direction .Then fireman can rotate it in any other direction to avoid obstacle if again another obstacle detects then it will again stop and move backward direction . Movement of robot is depends on movement of wheels. The above fig shows how to connect the L298 IC to control two motors. There are three input pins for each motor, including Input1, Input2 , and Enable1 for Motor1 and Input3, Input4, and Enable2 for Motor2.

2.4 Outputs And Discussion

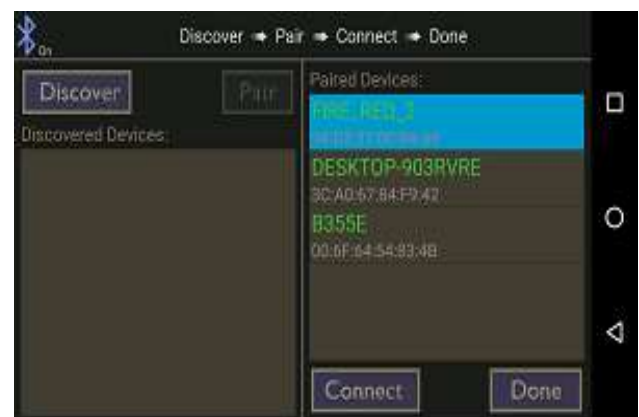


Fig -3 GUI for project



Fig -4: No obstacle is detected



Fig 5-Setup for testings



Fig -6:Obstacle Detected



Fig -7:when Obstacle is detected



Fig -8:Fire is Extinguished

In the fire-fighting robot project, the main aim was to develop a robot which will detect fire and extinguish it. In this project obstacle is detected by using ultrasonic sensor, fire is detected by temperature sensor and robot is moved to target using Bluetooth communication. A robot which is result of this project communicates with mobile application through Bluetooth and with microcontroller and other hardware using serial port communication. Micro-controller can handle both analog and digital data received from mobile app and hardware to detect fire and extinguish it. This project can be used in day today life if more professionals are selected. It can be used in markets, malls, stores, companies and even at homes. In this project fire is extinguished by water which is stored in water tank which is mounted on robot, instead of this we can carry water pump. For providing more safety we should add some obstacle detector sensors and temperature sensors to detect fire at left and right side.

4. CONCLUSIONS

Proposed approach of modular design strategy was a good solution in implementing the fire fighting robot to help people at the critical condition. The proposed robot can move in forward, backward, left, right and can stop also. It reduces human efforts and protect their property. Robot detects fire and extinguish the fire with the help of sprinkler pump. For extinguishing that fire robot has to reach up to there and it moves towards the target with the obstacle avoidance property. In this way robot can detect obstacle and avoid them also.

ACKNOWLEDGEMENT

We feel great pleasure in expressing our deepest sense of gratitude and sincere thanks to Prof. Suyavanshi, my guide Prof. M.D. Sale and Prof. Mande for their valuable guidance during the project work, without which it would have been very difficult task. This acknowledgement would be incomplete without expressing our special thanks to Prof. M. P.Wankhade Head of the Department (Computer Engineering) for their support during the work. We would also like to extend our heartfelt gratitude to our Principal, Dr. S. D. Lokhande who provided a lot of valuable support, mostly being behind the veils of college bureaucracy.

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