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DEVELOPMENT OF FIRE FIGHTING ROBOT FOR EXTINGUISHING FOREST FIRES

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***Abstract*— The forest fires are one of the danger calamities that occurring frequently, which becomes uncontrollable for longer time and wide range of species have become extinct. This project is to develop a fire fighting robot which is useful to detect and extinguish the fire without spreading it widely. In this project we use node mcu along with wi-fi module and camera to know exact location and detect more precisely.**

***Keywords*—forest fires, node mcu, camera, wi-fi module**

I. INTRODUCTION

Robotics is widely used now days where there is danger for humans to work. Such type of developments is fire extinguisher which is of robots. This is more useful because it takes a lot of time for a fire extinguish vehicle to go to the spot where the fire accidents take place.

Forest fires is major thing that is taking place frequently, recently in Australia, in California (U.S.A) which took a lot of time to bring the situation under control. In such situations firefighting robots are very crucial. They detect the fire before it spreads widely and also to control them.

This paper consists of problem statement, literature review, methodology and conclusion. Problem statement is about the issue we are focussing mainly for this project purpose.

Literature review gives brief research on this particular project based on previous papers and researches.

Methodology describes about the brief information on the components, block diagram, working of the block diagram.

II. PROBLEM STATEMENT

On an average of 72,400 wildfires burned an average of 7.0 million acres since 2000 every year. It has been increased from that of the 1990's average of 3.3million acres. In the year 2018 there were 58083 wildfires which burnt an average of 8.8 million acres globally and it is the sixth largest figure in terms of acreage burned. [1]

Over the past 10 years, there were an average of 67,000 wildfires annually and an average of 7.0 million acres burned annually. [1].

Table 1. Annual Wildfires and Acres Burned

	2014	2015	2016	2017	2018
Number of Fires (thousands)					
Federal	13.0	13.8	12.6	15.2	12.5
FS	*6.8*	*7.1*	*5.7*	*6.6*	*5.6*
DOI	*6.1*	*6.6*	*6.8*	*7.3*	*7.0*
Nonfederal	50.6	54.4	55.2	56.4	45.6
Total	**63.6**	**68.2**	**67.7**	**71.5**	**58.1**
Acres Burned (millions)					
Federal	2.15	7.41	3.00	6.3	4.6
FS	*0.87*	*1.92*	*1.25*	*2.9*	*2.3*
DOI	*1.24*	*5.47*	*1.70*	*3.3*	*2.3*
Nonfederal	1.4	2.72	2.51	3.7	4.1
Total	**3.60**	**10.13**	**5.51**	**10.0**	**8.8**

Table 2. FS and DOI Personnel and Loss Statistics

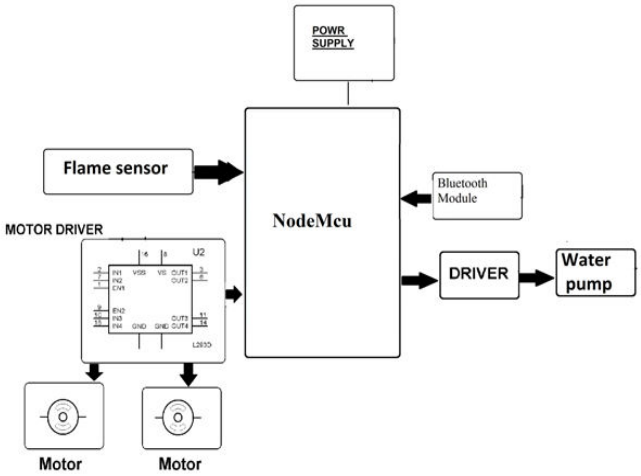
	2015	2016	2017	2018
Personnel				
FS Firefighters	10,000	10,000	10,000	10,000
DOI Firefighters	3,997	4,129	4,514	4,492
Losses				
Firefighter Fatalities	13	12	14	19
Structures Burned	4,636	4,312	12,306	25,790

The above two tables give the statistics of the forest fires that occurred every year on an average and the number of firefighters lost their lives during extinguishing the fires.

III. LITERATURE REVIEW

To design this robot, it will be tested like in a house model or by keeping a small piece of paper with fire and the robot should be able to detect the fire in the shortest time with the help of sensors and through wireless communication. [2].
In this movable robot consists of LM35 Flame Sensor which is used to detect the fire and distances on its way towards fire [2].
The human can control the robot manually by using the Bluetooth module through android application [2].
In this paper we are making use of node mcu as the main component, the code is written using open source arduino IDE.

IV. METHODOLOGY

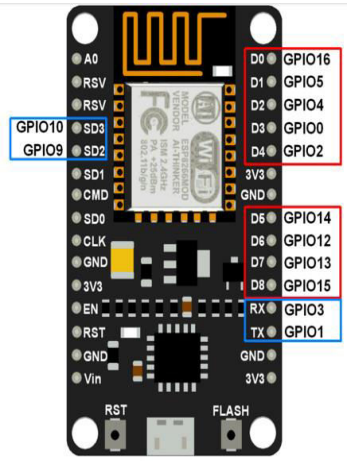


Here the main technical components are discussed for the respective prototype of the project. They are:

1. Node MCU
2. L293 driver
3. Flame sensor
4. Bluetooth Module

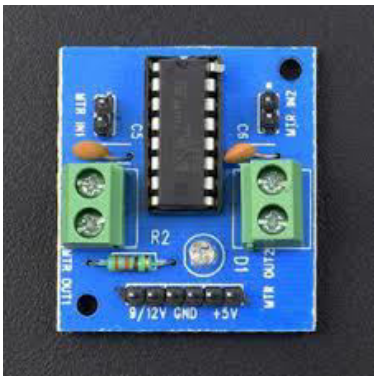
1. NodeMcu

Coming to the NODEMCU basically it is a WIFI module the particular serial number used in this ESP8266.This is the core heart of the project the whole signal processing is done over here
it acts like a medium where the signal is passing through it may be like an output or input. This consists of GPIO pins specifically these are used the number of GPIO pins present are 13 but in these 2 pins are
eventually used as the Tx and Rx remaining are the 11 pins. The interface voltage for communication purpose is 3.3. The data rates of this module to transfer the information is 2.4GHz
The Node mcu gets the input from different components in this particular project from flame sensor and bluetooth module.



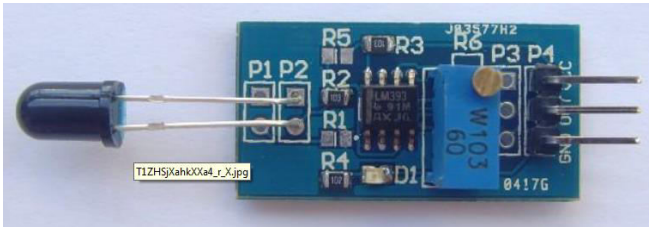
2. L293 driver

The locomotive element for this robotic project are the wheels with chassis which are rotated under the governance of the motor driver the driver used in this prototype is the L293D the D indicates the driver. This driver has typically constructed on the basis of the H bridge. It consists of four switches with power and the ground the basic power requires to operate the driver is 4.5V to 36V.It consists of 16 pins. Maximum of motors can be driven by it are two (2). Depending upon on the input signals it decides whether the motor need to move in clockwise or anticlockwise direction. It can be used for driving current LED'S of High value.



3. Flame sensor

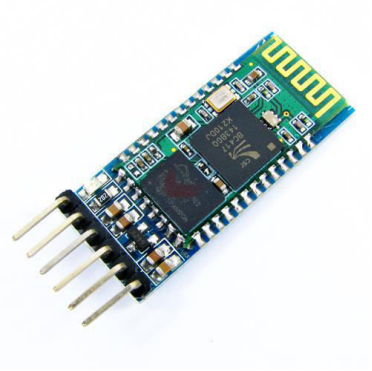
Flame sensor plays the key role in this project, here the input of this component is different to other devices as it takes the fundamental physical quantity and measures and gives the output in the desired electrical format this is done by any sensor but eventually it detects the flame. It can detect the light sources whose wavelength ranging from 760 nm to 1100 nm. The typical angle of the flame sensor for the detection of the flame is 60 degrees because where the spectrum of flame is sensitive at that point. Adjustments can be made for the sensitivity of the flame detection. It consists infrared receiver whose output is given to the voltage comparator LM393.These both components are situated on the flame sensor board itself. The main pins involving in the function of this sensor are GND, OUTPUT, VCC.



4. HC05 Bluetooth module

The HC05 Bluetooth module has a typical role in the whole project as it is the heart of the communication as per the prototype. It can be used in several modes but the default mode is slave mode. The disadvantage involving in the slave mode is that in the slave mode it cannot give instructions to other devices. It just has the ability to accept the instructions

or the orders passed on by the master devices it can be any robot. The modulation of the signal used in the HC05 is GFSK. Generally, it will be locked by the pin "1234". The rate of the data transmission is 9600kbps.The maximum range upto it can communicate comfortable is 30m.The module itself consists of integrated antenna which is the means of communication. The interface involved in the module is TTL. In general, it has 6 basic purpose pins. Coming to this prototype of the project here it takes the instructions from the paired android device which will far from the module here the module is acting as slave because it is taking the instructions from other device.



Working:

This robot consists of 2 Dc motors which run at a speed of 60 rpm, it is controlled by a bluetooth communication with the help of android application.
NodeMcu in a serial communication UART mode and the communication is governed on 9800bps to communicate it with the Bluetooth module.
In-order to sense fire we use the flame sensor, these sensors have an IR Receiver (Photodiode) which is used to detect the fire.
When fire is burnt, it emits a small amount of Infra-red light, which is received by the IR receiver on the sensor module. So that if a fire is detected the output pin (DO) will give 0V (LOW) and if the is no fire the output pin will be 5 V (HIGH). When fire is detected, it will automatically start pumping of water.

V. Conclusion

This project has so many applications, not only for forest fire but also for fire accidents that takes place at commercial places due to short circuit, at houses, chemical warehouses, etc., This project is controlled via bluetooth communication. It is very useful where the man cannot go.

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