Wireless Operating Robot for Disaster Management with Android Control

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Abstract: When a natural disaster like an earthquake hits a populated area or an accident like gas leakage takes place in a building, rescue teams have to get a quick overview of the situation in order to identify possible locations of victims, which need to be rescued, and dangerous locations, which need to be secured. In order to provide the rescue facility, advanced robots embedded with lots of sensors and functions are centre of attraction of people and researchers all around the world. The project is on the application of the Wireless Sensor Network for disaster management. The module made for wireless sensor network consists of a fixed node with the rescue team and a moving node with the robot. The robot module works as, searching for living human beings, and collects data from the air quality control module, localizes it with respect to the fixed nodes and sends the data. Thus Robot-supported systems accelerate search operations. The team of rescue members can wirelessly receive the data in real time. It provides a range up to 100 meters when operated at full power. Disaster Management refers to how we can protect or preserve maximum number of lives and property during a natural disaster. Disaster management plans are multi-layered and are aimed to address such issues as floods, hurricanes, fires, and even mass failure of utilities or the rapid spread of disease.

Index Terms **- Arduino UNO, LCD Module, Bluetooth Module, Wireless Sensor Network.**

I. INTRODUCTION

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electronic engineering, information engineering, computer science and others. Robotics deals with the design, construction, operation and use of robots as well as computer systems for their control, sensory feedback, and information processing. These technologies are used to develop the machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments.

The history of robotics has its origins in the ancient world. The modern concept began to be developed with the onset of the Industrial Revolution, which allowed the use of complex mechanics, and the subsequent introduction of electricity. This made it possible to power machines with small compact motors. In the early 20th century, the notion of a humanoid machine was developed. Today, one can envisage human-sized robots with the capacity for near-human thoughts and movement.

The first uses of modern robots were in factories as industrial robots – simple fixed machines capable of manufacturing tasks which allowed production with less need for human assistance. Digitally controlled industrial robots and robots using artificial intelligence have been built since the 2000s.

In 1898 Nikola Tesla demonstrated a prototype remote-controlled submarine at Madison Square Garden as "an automaton which left to itself, will act as through possessed of reason and without any willful control from the outside." He defended his invention against critical reporters, arguing that his automata were not a "wireless torpedo", but instead, a "mechanical men, which will do the laborious work of the human race.

In the 1950s, George Devol designed the Unmated, a robotic arm device that transported die castings in a General Motors plant in New Jersey, which started work in 1961. Unimation, the company Devol founded with robotic entrepreneur Joseph Engelberger, was the first robot manufacturing company.

Various techniques have emerged to develop the science of robotics and robots. One method is evolutionary robotics, in which a number of differing robots are submitted to tests. Those which perform best are used as a model to create a subsequent "generation" of robots. Another method is developmental robotics, which tracks changes and development within a single robot in the areas of problem-solving and other functions. Another new type of robot is just recently introduced which acts both as a smart phone and robot and is named RoboHon.

II. PREVIOUS WORK

Raghad Dardardiscuss a low cost and low power consumption robot used for guiding rescue teams when disasters happen using wireless sensor network.

Albert W. Y. Ko and Henry Y. K. Lau and discuss various things about rescue mechanisms including camera mounted probes, search dogs, and audio devices. The paper by Trupti B. Bhondve proposes a monitoring system using sensors unit and camera module to record, analyze conditions of human body and transmit data.

Tsuyoshi Suzuki, Ryuji Sugizaki describes an autonomous deployment and restoration of a Wireless Sensor Network (WSN) using mobile robots. Kamol Chuengsatiansup explained about a team of search robots for rescue missions.

D.Kurabayashi describes a survey of studies on collective intelligence of autonomous robotic agents, especially emergent functionality in a swarm. Paper by Kuntze, Helge-Bjoern

D.I Gertman discusses about increasing the range of higher level robot behaviors such as autonomous navigation and mapping and reports on experiments underway intelligence residing on the robot to enhance emergency response.

ROACH is a design that provides significant advantages in mobility over wheeled and tracked designs.It is equipped with cameras which transmit live audio and videos of the disaster site, as well as information about locations of objects with respect to the robot's position to the interface on the laptop. Kohga: University of Tokyo - The most complicated task for most of the USAR robots has been working on a rough terrain. Specialized robots have been designed for these types of environments such as KOHGA the snake like robot.The robot is constructed by connecting multiple crawler vehicles serially, resulting in a long and thin structure so that it can enter narrow space.

System for disasters made up of four parts sensor, mobile rescue robot, transmission network, monitoring center. When victims are trapped inside debris, it will be difficult to search and rescue them quickly. At this situation Mobile robots are use that can go inside the building and detect if any victim is present and then signal the crewmembers for recovery. The purpose of using mobile rescue robots is to track the victims in disaster area. Disasters come with many obstacles for the rescue team that makes it hard for them to reach the victims, for example rainstorms, collapsed buildings, obstructions and dangerous substances. The rescue team must fast and securely find information of the disaster areas, so disaster area is covered by mobile rescue robot to rescue people which are injured survivor, unconscious survivor etc.

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III. EXISTING SYSTEM

Disasters themselves are not limited to specific parts of world, though certain areas might be more prone to certain specific types of disasters. Some countries are more prone to terrorist activities, some coastal areas are more prone to cyclones, some areas are more prone to floods while some other areas are prone to oil spills. Loss of human life and property are obvious consequences of disasters. However, the level of preparedness is the key element that can limit the extent of damage. Use of sensor network based technologies can enhance the level of preparedness and the ability to handle consequences of the disaster. This higher level of preparedness can provide a better control over the loss. A team of mobile robots can quickly set up a network of mobile sensors and actuators for rapid action. This talk presents an overview of applications of distributed mobile robots in disaster management.

The Robot is equipped with both RF module as well as Bluetooth module. Radio link is used where long distance communication is required. It provides a range up to 100 meters when operated at full power. Bluetooth Module provides full duplex mode of communication but it provides range up to 20 meters. The Robot can be operated through any android device. Android device establishes connection with robot through Bluetooth. All the readings from different sensors are displayed on android device. The general architecture of robot with different wireless network is mentioned. Block diagram of Existing System is shown in Fig. 1.

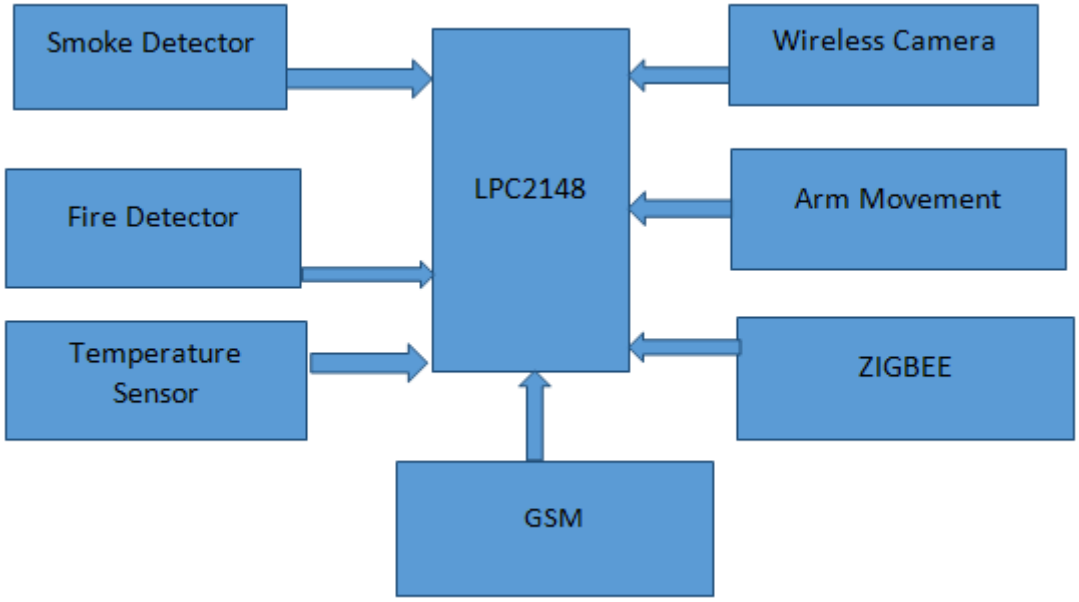

Fig. 1: Block diagram of Existing System

3.1. Existing System with Wire

Rescue robots use components and technology found in most other robots used for commercial purposes. Actuators and other electric motors, accelerometers, gyroscopes and dozens of sensors and cameras providing 360º views enable these robots to maintain balance while moving over uneven ground covered with rubble or debris, and to get a sense of the environment around them. Robots of all kinds play a growing role in supporting SAR teams. Increasing autonomy will create more capable ground robots, while a combination of rapid technological advances and regulation should see the market for disaster relief drones soar over the next five years. The conventional methods used in disaster management, which are characterized by human rescuers and dogs, fall increasingly short of being able to meet the complex requirements posed by such events. Initial experience during rescue work at the destroyed World Trade Center in New York proved that the use of robots and sensors results in a more efficient search for victims and sources of danger and relieves the emergency services.

3.2. Existing System with Wireless

The Robot is equipped with both RF module as well as Bluetooth module. Radio link is used where long distance communication is required. It provides a range up to 100 meters when operated at full power. Bluetooth Module provides full duplex mode of communication but it provides range up to 20 meters. The Robot can be operated through any android device. Android device establishes connection with robot through Bluetooth. All the readings from different sensors are displayed on android device. The general architecture of robot with different wireless network**.** To operate robot through radio link, a separate remote is used. It has two different RF module clocked at 315MHz and 433 MHz The two different frequency are used to avoid the chances of inter channel interference. The interfacing of the different sensors is done through Arduino UNO board since

Arduino is an open source microcontroller so modification of robot is very easy through any computer. The robot is equipped with LPG gas module, Temperature and humidity sensor light sensor, Magnetic field sensor, Metal detector. It has a live camera that is equipped with two-way audio communication, Day and Night vision. Camera provides live streaming without any delay over wireless link at 2.4 GHz ISM band. Robot is having a latest 18650 Battery which can provide power for three hours at single charge. The process flow chart Existing Method is shown in Fig. 2.

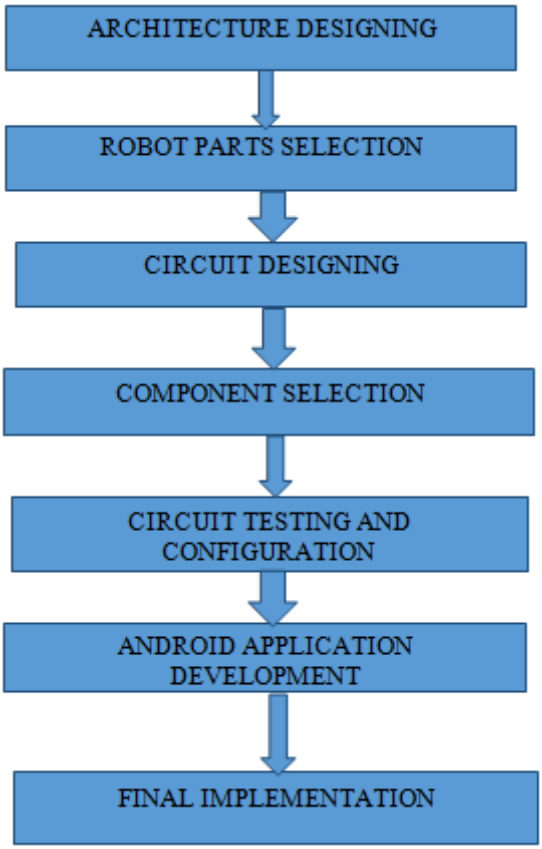

Fig. 2 Process Flow chart

IV. PROPOSED SYSTEM

In this proposed system, we have designed a Disaster Monitoring Robot with Android Controlled Application. This type Robot is mostly useful in disaster affected areas. This robot can be used to view affected area very precisely. Because of its small size and wireless communication, this robot can be send to such places where human entry is not possible. This Robot is designed using Arduino UNO Microcontroller Development Board. Android based application is used to communicate and control the Robot using Bluetooth Technology. This Robot can be moved forward, Backward, Left and Right direction. L293D motor driver is used for the Clockwise and Anticlockwise direction of DC Geared Motor. Wireless RF Camera is interfaced with this Robot for Remote Monitoring of the affected Location.

The power supply setup of the system contains a step down transformer of 230/12V, used to step down the voltage to 12VAC. To convert it to DC, a bridge rectifier is used. Capacitive filter is used to remove ripple from DC Supply. 7805 voltage regulator is used to regulate input voltage to +5V and 7809 is used to regulate input voltage to 9V DC and 7812 is use to regulated input voltage to 12V DC. 5V DC is used by LCD Module and Bluetooth Module, 12V DC is used by Arduino UNO Module and 9V Dc is used by the Wireless RF Camera. The proposed system block diagram is shown in Fig. 3.

6.1Major Components used in this Proposed System:

- Arduino UNO
- LCD 2x16 Module
- L293D Module
- DC Geared Motor
- Bluetooth Module
- 12V Battery
- 12V Transformer
- Wireless Camera
- Voltage Regulators
- Filter Capacitors
- Diodes
- LED
- Resistor

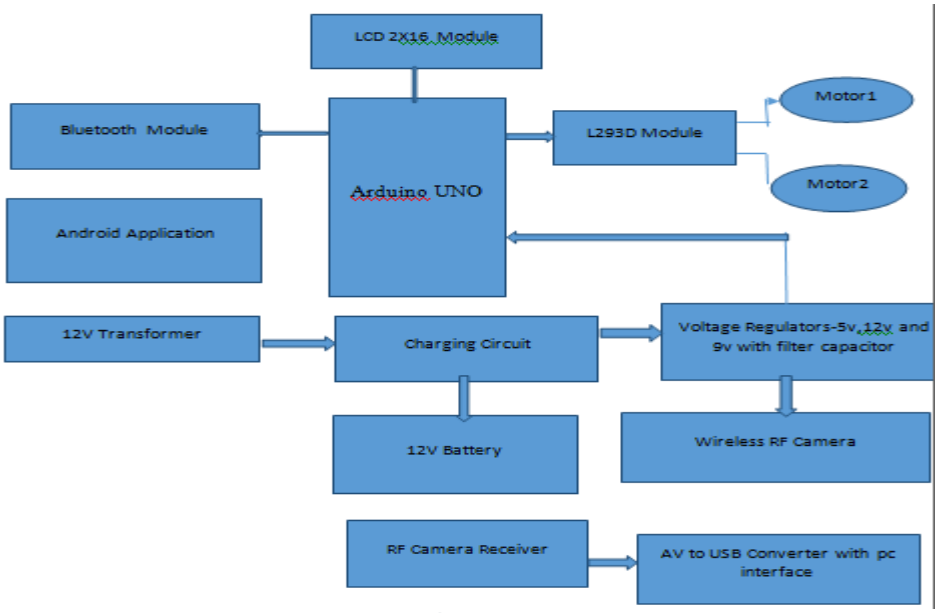

Fig. 3 Proposed system Block diagram

V. RESULTS DISCUSSION

Android Application for this robot is made by using an open-source web application called App Inventor for Android which is maintained by the Massachusetts Institute of Technology (MIT). Android application uses a graphical interface, very similar to Scratch and the Star Logo TNG user interface that allows users to drag-and-drop visual objects to create an application that run on Android devices.

Android software like App Inventor includes a designer window in which a program's components for robot movement are specified by using visible components, such as images and buttons, which are placed on a simulated screen area so that buttons can be easily accessed by the operator. The App inventor's blocks editor is used to create the program logic to perform appropriate function every time operator hit a button. This android application uses the Bluetooth module of the Android device to communicate with the robot. It can transfer data as well receive the data from the robot. It can receive all of the sensors readings and can display them on the device screen. The proposed system proto type is shown in Fig. 4..

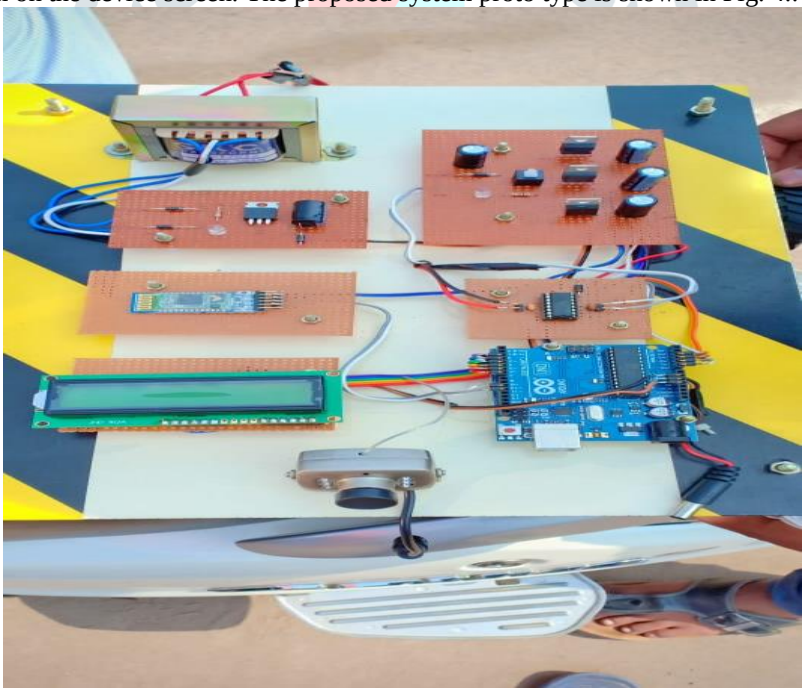

Fig. 4 Wireless Operating Robot with Disaster Management

Overall process of prototype describe in the form of flow chart is shown in Fig. 5.

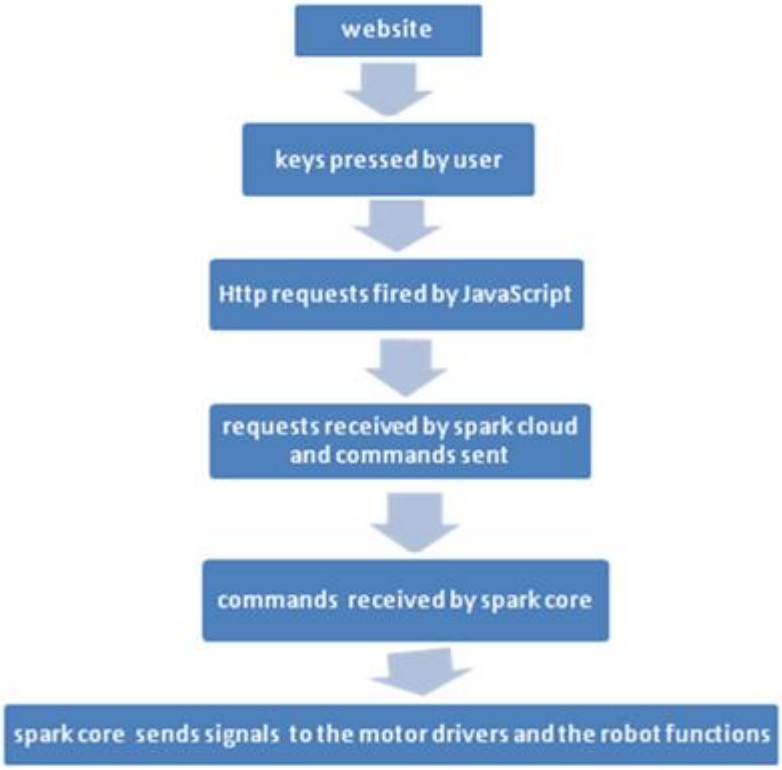

Fig. 5 Process Flowchart

VI. CONCLUSION

In this paper, we achieved control both wireless communication between the mobile Robot Android GUI Application. The main tasks of this paper make a surveillance robot which can be control by emerging android technology. It gives versatile operation of robot controller which need not modify the hardware. This system can further be developed by enhancing the performance and by adding more features. Further development of this system depends on the application we are using an area of work. The system can be added features like gas sensor, thermal image sensing, connecting robotic arms and can be used in pick and place purposes etc… can be done. The development of this system has wide area of applications such as in Military and Law enforcement and Industrial and in Disaster management and so on.

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