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DESIGN OF IOT CONTROLLED ROBOT FOR CRITICAL ENVIRONMENT MONITORING USING ARM CORTEX CONTROLLER

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Abstract:
A robot is a machine designed to execute one or more tasks automatically with speed and precision. There are as many different types of robots as there are tasks for them to perform. A robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Many robots have been built for manufacturing purpose and can be found in factories around the world.The main aim of this project is to design a IoT Controlled robot using Wireless technology in the Real Time Operating System(RTOS) environment using an advanced microcontroller (ARM Cortex). Nowadays, robots plays a major role in all human activities like house maintenance, aerospace, factories, lifting of heavy equipment, etc. It will also help to do the risky jobs which cannot do by humans such as mining. The main aim of this project is to extend the use of robots in national defense system or in any risky environment.

Keyword: Wireless Technology, Robotics Remote based Controlling, ARM Cortex, Real Time Operating System (RTOS), LM393D

1.Introduction

The Army's remote-controlled, bomb-finding robots aren't finding enough bombs in Afghanistan. So, the military is toying with a new notion: Let the robot drive itself; and make it bigger, like the size of a golf cart. In a recent solicitation for small businesses, the Army expresses interest in a remote-controlled vehicle that's bigger than most robots but (way) smaller than its fleet of tactical vehicles. Really, it's a software system outfitted with sensors for detecting a variety of bombs – "pressure activated devices and command detonated explosive devices" alike – that can turn an existing "mid-sized" vehicle into a self-driving or remotely-controlled car. The so-called "Intelligent Behavior Engine" has to support "skid steer hydraulic arm attachments" – Doctor Octopus-like robot arms, to defuse the bombs it finds. And it's got to weigh between 500 and 3000 pounds (the size of a golf cart, Smart car, or John Deere Gator), making it hypothetically "capable of traversing long distances on narrow, rugged paths. “It was just two months ago that the Army announced it would buy dozens of radar add-ones for armored Husky vehicles to spot and stop

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improvised explosive devices, a $106.5 million push.

Figure 1: The Basic IoT Architecture.

But the solicitation says the bulky Husky isn't right for Afghanistan since it "cannot traverse the rugged terrain and narrow paths" that pass for the country's bomb-infested roads.That exact same concern led the Army to put out a call last month for new bomb-detecting robots that can traverse "rough terrain, 45-degree hills, rocks, holes, culverts and other obstacles." Only there, the Army wanted to move in the opposite direction, shrinking robots down from several hundred pounds, not bulking them up to car-like sizes and marching them for up to 30 miles at a time. Still, in a vote of no-confidence in the robot fleet, the solicitation laments that "currently fielded technologies have limited utility for defeat of IEDs on narrow unimproved routes during deep insertions into rugged terrain."Ideally, the Intelligent Behavior Engine will have "off-board, 'back-seat driving' capabilities" – controls that let troops on patrol operate the car remotely, using it for "scanning, digging and emplacing explosive charges" when it senses a bomb nearby. The Army doesn't have either software or a vehicle design in mind, but it says that it'll favor "intelligent, adaptive software behaviors that provide standoff operation in terms of navigation, detection and neutralization." In other words, when the car finds an improvised explosive device, it should know how to safely avoid, defuse or detonate it.

2. Literature Survey

Robotics Automation is defined as a technology that is concerned with the use of Mechanical, electronic, and computer-based systems in the operation and Control of production. This technology includes transfer lines, mechanized Assembly machines, feedback control systems, and robots. There are three Broad classes of industrial automation: fixed automation, programmable Automation, and flexible automation. Of these three types, robotics coincides most closely with programmable Automation. The robot can be programmed to move its arm through a sequence of motions in order to perform some useful task. It will repeat. That motion pattern over and over again until reprogrammed to perform. Some other task. Hence the programming feature allows robots to be used for a variety of different industrial operations, many of which involve the Robot working together with other pieces of automated or semiautomatic.

1. Smart Home Automation: A Literature Review Vaishnavi S.Gunge, Walchand Institute of Technology, SolapuR. The work deals with discussion about different intelligent home automation systems and technologies from a various features standpoint. The work focuses on concept of home automation where the monitoring and control operations are

facilitating through smart devices installed in residential buildings.

2. A Survey on Internet of Things Based Home Automation System Pooja N.Pawar1, B.E Student, Dept. Of CSE, IJIRCCE a low cost and user friendly smart home system, which uses an Android application to communicate with the cloud and provides switching functionalities, is presented. Unlike the similar system which uses either of the Bluetooth module network, the proposed system uses Internet of Things (IoT) for monitoring and controlling the Electrical applications demonstrate the effectiveness and feasibility of the system.Automated Fire Detection Surveillance System: A large scale Industries and big factories are largely affected by the short circuits and blunders done by the employs. These blunder causes highly damages to the industries. A small mistakes can lit up the entire machines in fractions of seconds. So These fire detection surveillance system consists of raspberry pi which consists of smoke sensor and flame sensor. It can detect wherever the smoke and flame inside the room where these sensors are fixed. And it contains capture camera that which capture images. Whenever the fire occurs in the room the IR sensors level increased to high level than normal. So the alert message sends to the raspberry pi. This raspberry pi activates the web camera and captures the images of room where the fire detected and sends these images to the URL link which is already fed to database by the client through internet. The main concept of these fire detection surveillance system is reduce the false alarms of the fire detection using web camera. Real time video surveillance system using motion detection: The technology is reaching the new phases day by day. the efficiency of the work increases and time duration decreases. So to save the life of the soldiers in country borders where are invented a robot for video surveillance in between the lOC (line of control) to protect the country from intruders without loose any valuable life of the soldiers . These real time video surveillance robot consist of web camera which is in activate of 24/7 time. Whenever the motion occurs infront of the cam it starts recording the video and stored into the database the client already fix to it. They consist of a combination of an infrared light emitting device and an infrared light sensor where These sensors are merely proximity detectors, they cannot determine the range of the obstacle in front. The range of these sensors is limited to a maximum of 80cm.

3. Ultrasonic range sensors, which determine the range of the object in front of it. They work by sending a short burst of ultrasonic waves and measuring the time taken for the echo to be received. They have a wide beam angle, typically 30. Obstacle avoidance for a mobile exploration robot using a single ultrasonic range sensor: The primary challenge of the robot which is moving from one place to another place is obstacle avoidance. If the robot can't check the exact obstacles which are to be avoided .it cant move from place to place without get interrupted. these obstacles can be avoided using the obstacle avoidance for a mobile exploration robot using a single Ultrasonic range sensor these consists of two types 1. Bump sensors, which are micro-switches activated when the robot touches an

obstacle. This is a simple, inexpensive method of obstacle detection, but operates only on contact, which makes it useful only for slow moving robots. 2. Infrared proximity detectors, which detect the presence of an object in front of the sensor. They consist of a combination of an infrared light emitting device and an infrared light sensor. These sensors are merely proximity detectors, they cannot determine the range of the obstacle in front. The range of these sensors is also limited to a maximum of 80cm. 3. Ultrasonic range sensors, which determine the range of the object in front of it. They work by sending a short burst of ultrasonic waves, and measuring the time taken for the echo to be received. They have a wide beam angle, typically 30. These sensors have ranges of up to 6m. 4. Laser range finders, which work on the same principle as ultrasonic range sensors, except that they use LASER instead of ultrasound. Laser range finders have a range of upto 30m, and are very accurate, having an angular resolution of upto 0.25.

3. Internet of Things (IOT)

There is no unique definition available for Internet of Things that is acceptable by the world community of users. In fact, there are many different groups including academicians, researchers, practitioners, innovators, developers and corporate people that have defined the term, although its initial use has been attributed to Kevin Ashton, an expert on digital innovation. What all of the definitions have in common is the idea that the first version of the Internet was about data created by people, while the next version is about data created by things. The best definition for the Internet of Things would be: An open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment‖ Internet of Things is maturing and continues to be the latest, most hyped concept in the IT world. Over the last decade the term Internet of Things (IoT) has attracted attention by projecting the vision of a global infrastructure of networked physical objects, enabling anytime, anyplace connectivity for anything and not only for any one. The Internet of Things can also be considered as a global network which allows the communication. Between human-to-human, human-to-things and things-to-things, which is anything in the world by providing unique identity to each and every object.

4. Implementation

Our project implemented by using RTOS with advanced microcontroller (ARM Cortex). In our project we can control the robot by using wireless communication i.e. from Control section (acts as transmitter) we are sending the control signals, then the robot receives (acts as receiver) the signals, according to the signals being received the direction of the robot is controlled. It also contains an automated unmanned system being designed around a microcontroller which serves for detecting hazardous parameters such as metal detection. According to this project, a robot is designed which is made to move all the time. Apart from this, the system also detects the presence of any metal with the help of a metal detector. All the devices such as metal detector, motor by which robot is made to move, buzzer are being interfaced to microcontroller which forms the

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control unit of the project. In the standby mode the robot is moved here and there. Whenever any metal is detected by the metal detector, the same is sensed and is intimated to the user by the microcontroller using buzzer. This project finds its place in places where one wants to make the unmanned system to sense some hazardous condition. In this project we are going to merge two applications that is spying and bomb detection.

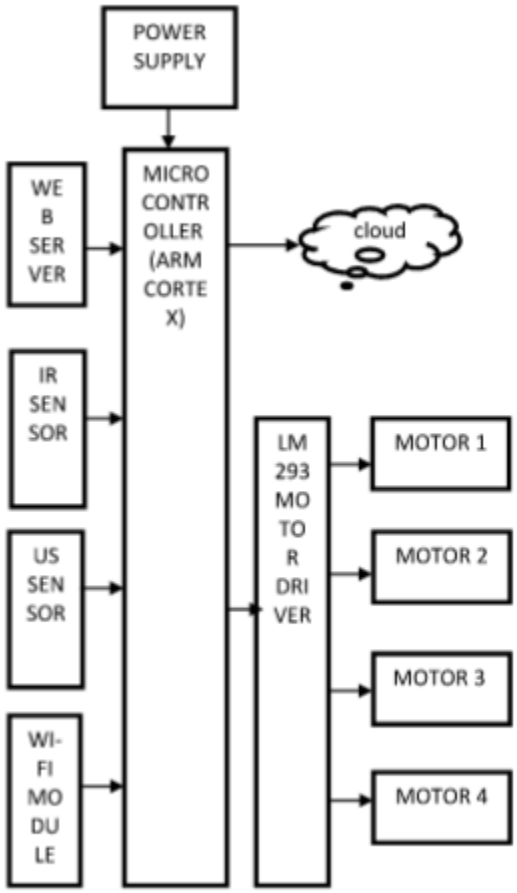

Figure 2: The Block Diagram of Implemented Project.

The Mini Spy Robot is small robot with a camera attached to it. The motors will be run by the relays which will be then controlled through Remote via RF module. The work is designed to develop a War field robot which is capable of detecting bombs land mines in its path and which is wirelessly controlled through RF module. It is used to monitor the Warfield. The robot can be moved in all the directions using the remote wirelessly. The robot system is also used for bomb detection. The controlling device of the whole system is a ARM Cortex. Due to that circuit complexity is reduced and performance speed is increased. Whenever, land mines or bombs are detected, it alerts through buzzer ringing system.

Motor driver L293D

The L293 and L293D devices are quadruple high current half H-Drivers. The L293 is designed to provide bidirectional drive currents of upto 1A at voltage from4.5V to 36V. The L293D is designed to provide bidirectional drive currents of upto 600mA at voltages from 4.5V to 36V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high current/ high voltage loads in positive supply applications.

DC Motors

Almost every mechanical movement that we see around us is accomplished by an electrical motor. Electric machines are means of converting electrical energy into mechanical energy. Electric motor is used to power hundreds of devices we use in everyday life. An example of small motor applications includes motors used in automobiles, robot, hand power tools and food blenders. Micro-machines are electric machines with parts with the size of red blood cells and find many applications in medicine.

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ARM Cortex Controller

Arm Cortex-A processors are at the heart of the most powerful and compelling technology products. They are deployed in laptop devices, networking infrastructure, home and consumer devices, automotive in-vehicle infotainment and driver automation systems, and embedded designs. Cortex-A processors power intelligent solutions, from edge to cloud, for next-generation experiences.

RTOS

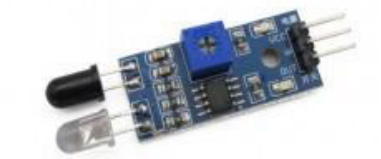
A real-time operating system (RTOS) is an Operating system(OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays. Processing time requirements (including any OS delay) are measured in tenths of seconds or shorter increments of time. A real time system is a time bound system which has well defined fixed time constraints. Processing must be done within the defined constraints or the system will fail. They either are event driven or time sharing. Event driven systems switch between tasks based on their priorities while time sharing systems switch the task based on clock interrupts.

Ultrasonic Sensor

Ultrasonic sensor provides an easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects. Interfacing to a microcontroller is a snap

A single I/O pin is used to trigger an ultrasonic burst (well above human hearing) and then "listen" for the echo return pulse. The sensor measures the time required for the echo return, and returns this value to the microcontroller as a variable-width pulse via the same I/O pin.

IR Sensor



IR Sensor module has great adaptive capability of the ambient light, having a pair of infrared transmitter and the receiver tube, the infrared emitting tube to emit a certain frequency, encounters an obstacle detection direction (reflecting surface), infrared reflected back to the receiver tube receiving, after a comparator circuit processing, the green LED lights up, while the signal output will output digital signal (a low-level signal), through the potentiometer knob to adjust the detection distance, the effective distance range 2 ~ 10cm working voltage of 3.3V-5V. The detection range of the sensor can be adjusted by the potentiometer, with little interference, easy to assemble, easy to use features, can be widely used robot obstacle avoidance, obstacle avoidance car assembly line count and black-and-white line tracking and many other occasions.

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4. Working, Execution & Results

The proposed system consists of transmitter and receiver circuit. The transmitter circuit transmits the commands required to operate the robot. The receiver circuit receives these commands through Web page and moves the robot according to the received commands. A metal detector is interfaced to the controller in the receiver side. Thus, whenever any metal is detected the robot stops there and buzzer starts ringing.

- Initially burn the code into the microcontroller using flash magic.
- Now switch on the power supply for the circuit.
- Now send the command '1' using the transmitter.
- This is transmitted to the receiver.
- At the receiver side receiver receives these commands and moves the robot according to the commands.
- The following commands moves the robot in the specified directions
- Forward
- Backward
- Left
- Right

While robot is moving if any metal is detected in its path, the robot stops there ringing the buzzer. Again, it starts moving when the commands are sent from the transmitter.

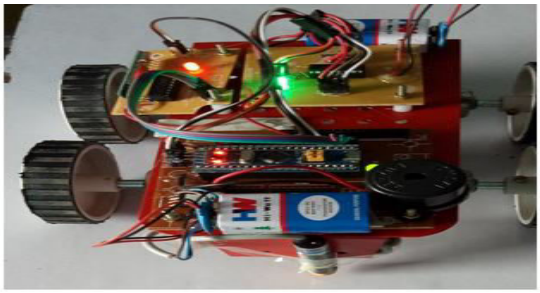

Figure 3: The Implemented Prototype Kit.

Algorithm

- Initially, declare port2 as input as this is connected to the decoded input.
- Now declare port1 as output as the motor pins of the robot are connected to the port1.
- Enable the external interrupt.
- Now check the input of port2.
- If the received value is equal to 1 then move the robot in forward direction by making port value as 0x01.similarly move the robot according to the input value.
- When interrupt occurs make the output pins to the motor low. This is written in ISR.

Applications

- These robots are used in detecting landmines.
- Robots are used for in detecting the minerals present in the ground.
- These robots are used for detecting the bombs.
- These can be used in construction industry for locating steel bars present in concrete.
- They are used in airports and building security to detect the weapons.

5. Conclusion & Future Work

It detects the IoT Command send by Web page and according to that control robot in Forward, backward, left turn, right turn movements. And it gives the information of US Sensor and IR Sensor data to the cloud. In this manner our project plays a crucial role in Military as well as in ourpolice department. In this project, we have introduces a new application using two techniques i.e. spying and Monitoring, Object detection implemented by using ARM Cortex with RTOS kit. In future, we can also implement bomb detection and diffusion technique in this project. It can be used in radar

detection systems to detect objects by implementing other hardware. It is concluded that smart living will gradually turn into reality that consumer can control their home remotely and wirelessly. The knowledge is ever expanding and so are the problems which the mankind strives to solve. In this spirit, it is hoped that the current activity will lead to further enhancements. For example, work on future for defense applications.

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