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Rescue Robot: A solution to Borewell Hazards

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Abstract: **— Nowadays cases of children getting trapped in unused bore wells are increasing. The rescue of such children becomes difficult due to lack of proper awareness about the health condition of the children trapped in bore well. Even the depth at which child is trapped makes the rescue work a difficult. The present system uses releasing cameras into bore wells by means of tugs to get information about the victim which won't give reliable results. 'The Rescue Robot' is a creative innovation that solves these problems in rescue field up to a certain extent. This is a 3 wheel robot capable of moving vertically upwards & downwards by means of motors in bore wells. The motion is controlled by a remote Laptop via zigbee module. The objectives of the project includes wireless controlling of Robot through PC using Zigbee technology, live audio and video reception and implementation of pick and place concept to the robot..**

Keywords: Zigbee

1. INTRODUCTION

Back in July 2006, almost all of India got glued to the television screens as the national media aired the rescue operation of the 5-year old kid, named Prince, who was stuck a 55 foot deep bore-well. It took the rescuers a total of 49 hours to successfully rescue Prince. Since then there have been several incidents where the innocent kids trapped inside bore-well could not be saved. In the current scenario cases of children getting trapped in unused bore wells are increasing. The rescue of such children becomes difficult due to lack of proper awareness about the health conditions of the children trapped in the bore well. The depth at which child is trapped also makes the rescue work a difficult one. The present system uses releasing cameras into bore wells by means of tugs to get information about the victim which will give reliable results. Possibilities of damaging the body of sufferer during the rescue operation loom large. The shift arrangements are made to pull out the body of sufferer. Some kind of hooks are used and victims clothes or body organs get caught hold of and this may cause wounds on the affected body. Rescue team spend hours and sometime days in futile attempt to save these little kids. In most cases they are unable to save the kids. In normal rescue operation a parallel pit is dug deep to achieve the child and adjacent holes are made to the wall of bore well.

A common method used to find the depth of child is the use of rope. The injuries during and throughout the rescue operation also leads to the death of child. The lack of oxygen inside the deep hole makes it impossible for the child to survive for long time.

2. WORKING

The three sensors IR sensor, PIR sensor, LM35 temperature sensor are connected to input port terminals of PIC16F877A respectively. The PIR Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. Temperature sensor has an output voltage proportional to Celsius temperature and it draws only 60 micro amperes from the supply. PIC is programmed in such a way that it processes the input data by making its output ports interfacing with the LCD or a computer. By this motion of trapped child can be visualized. Serial data is sent through a Zigbee module which is interfaced to PIC through MAX232.The module operate with in the 2.4GHz frequency band. The two gear motors are controlled by means of PIC16F877A through driver circuit.Since direct supply from PIC won't be sufficient to drive the motor it is interfaced through driver circuit.

2.1 Block Diagram

The block schematic representation of the project is shown here. It consists of a sub system and base system. The base system is a computer peripheral and subsystem represents the robot. The sub system consists of Zigbee modules, PIC Microcontroller, RF Receiver and Transmitter, Depth Calculator, Sensors and lighting systems. The base system is a laptop which controls the subsystem via Zigbee module. The features incorporated in this system includes a good video capturing device with proper lighting which sends the videos of trapped child to the external world live. It helps to analyze the present condition of the child by monitoring the videos obtained at the base station, a radio transmitter module which

helps to give instructions to the trapped person. By the transmitter module at base station the rescuers or mother give necessary guidelines and confidence. Sensors like temperature sensor, IR sensor etc are incorporated on the robot, so that the rescuers can analyze what provisions are to be provided. Along with the video, the robot also sends its present depth distance, so that the rescuers can correctly understand the depth at which the victim is trapped. It can be used to carry small objects like food materials to the victim.

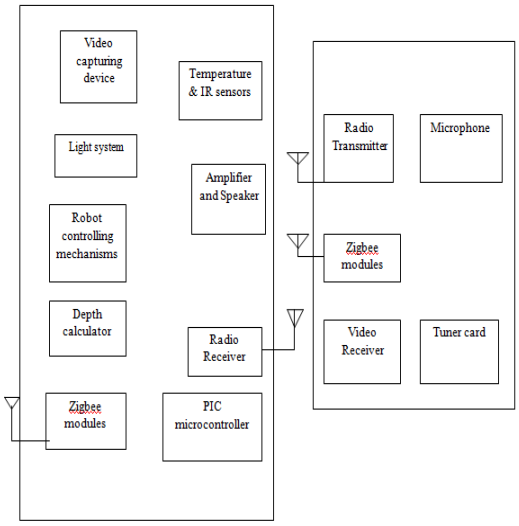

Figure 1: Block Diagram

2.5 Circuit Diagram

The circuit diagram of the system is shown in Fig 2. It consists of a 5V regulated supply, motor and its driver circuits, sensors, PIC 16F877A, zigbee module and LED lights. The available voltage signals from the mains is 230V & 50Hz which is an AC voltage, but required is dc voltage with the amplitude of +5V and 12V for various applications. In this section we have a diode bridge rectifier and voltage regulators for +5V and +12V via a capacitor. The 3 sensors IR sensor, PIR sensor, LM35 temperature sensors are connected to input port terminals of PIC 16F877A respectively. The PIR Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. Temperature sensor has an output voltage proportional to Celsius temperature and it draws only 60 micro amperes from its supply. PIC is programmed in such a way that it processes the input data by making its output ports interfacing with the LCD or a computer. The motion of trapped child can be visualized. Serial data is sent through a Zigbee module which is interfaced to PIC through MAX 232.The module operate within the 2.4GHz frequency band. The two gear motors are controlled by means of PIC 16F877A through driver circuit.Since direct supply from PIC will not be sufficient to drive the motor, it is interfaced through driver circuit.

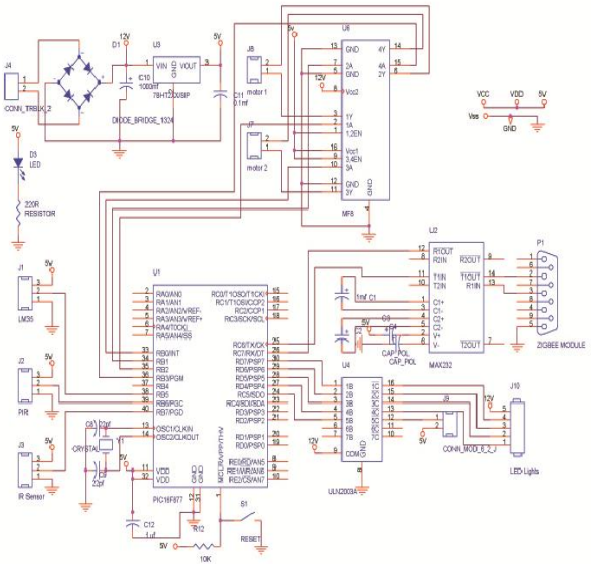

Figure 2: Circuit Diagram

3.1 Program Algorithm

The program algorithm is explained below.
Step 1: Switch on the power supply.
Step 2a: Turn on docklight software
Step 2b: Turn on video capturing module.
Step 4: Control commands are given via a xbee.
Step 5: Ports are initialized
Step 6: Human presence is checked.
Step 7: Temperature and distance are taken
Step 8: Arm locking mechanism is activated.
Step9: Trapped child is rescued.

3.HARDWARE

3.1 PIC 16F877A

The microcontroller unit used here is a PIC 16F877A. The core controller is a mid range family having a built-in SPI master. 16F877A have enough I/O lines for current need. It is capable of initiating all intersystem communications. The master controller controls each functions of the system with a supporting device. Also responsible for reception of commands from the host and taking necessary actions. This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 comparators,8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

3.2 Zigbee

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15 standard. Though its low power consumption limits transmission distances to 10 100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbps, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

3.3 LM 35 temperature sensor

Thermistors are thermally sensitive resistors whose prime function is to exhibit a large, predictable and precise change in electrical resistance when subjected to a corresponding change in body temperature. Negative Temperature Coeffcient (NTC) thermistors exhibit a decrease in electrical resistance when subjected to an increase in body temperature and Positive Temperature Coefficient (PTC) thermistors exhibit an increase in electrical resistance when subjected to an increase in body temperature.

3.4 Infrared Proximity Sensor

PIR Sensor is used to detect objects and obstacles in front of sensor. It keeps on transmitting modulated infrared light. When any object comes near, it is detected by the sensor by monitoring the reflected light from the object and is operated based on the principle of pyroelectricity. An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Moving objects of similar temperature to the background but different surface characteristics may also have a different infrared emission pattern, and thus sometimes trigger the detector.

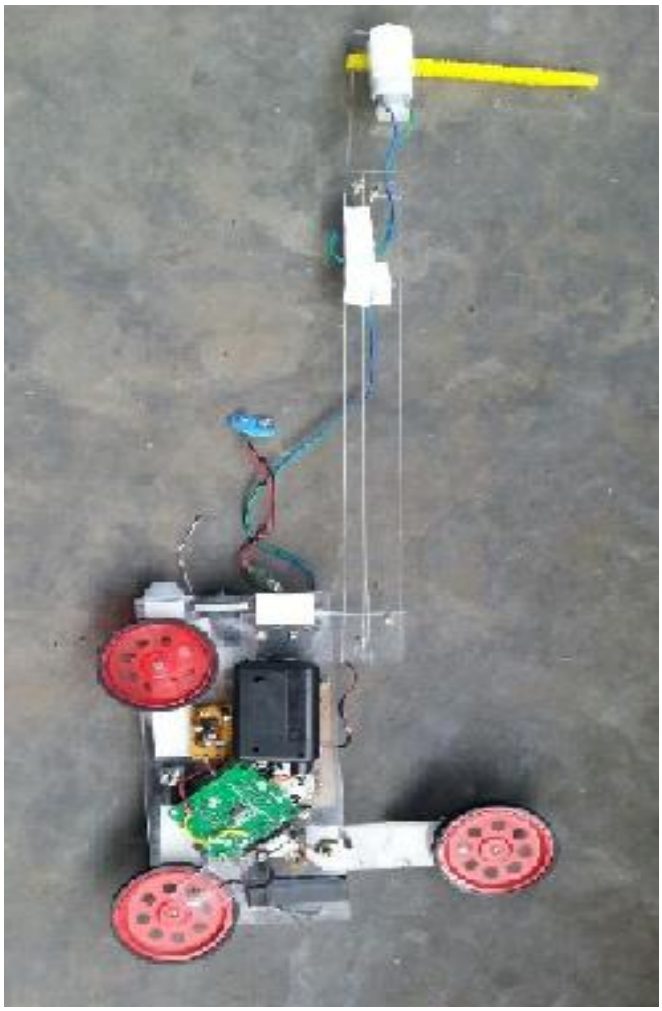

Fig.3 Final Hardware

CONCLUSION

The robot designed is able to give the conceptual scenario in the situation of rescuing child from borehole which can be made in use by the government. By using this concept, robots for this situation can be made on large scale for saving the life of the child. It is able to see the irregularities of pipe by giving the inside view. To design rescue robots for saving people trapped in bore wells, three criteria are considered. Supplying oxygen to the victim trapped inside the bore well, picking him/her up safely without failing or slipping of robot in between, rescuing out the victim safely as fast as possible. Considering the above criteria rescue robot was designed. The reason that these rescue robots are not ready for the market or common use is that they fail to serve one or more of the above mentioned criteria. Hence every aspect of design was taken care to make sure that our design satisfies above mentioned criteria to a good extent.

The system as it is right now, has temperature sensor, lighting system, distance measurement and an arm for pick and place mechanism. As an improvisation and future scope we could add motors with higher rating, also oxygen sensors and cylinders can be added on to robot. An air bag can be added as a more safer and reliable alternative than the robotic arm to lock the child from sliding down further.

3. ACKNOWLEDGEMENT

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