SMART MACHINE APPLICATION TO MAKE A FIRE MONITORING SYSTEM MORE DEPENDABLE

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ABSTRACT: The dependability of a fire monitoring system can be improved by introducing a mobile smart machine in addition to the fixed IOT sensors .The parameter values obtained from the fixed sensors can prove to be inaccurate .The mobile smart machine, equipped with the temperature, smoke and gas sensor is introduced to acquire more reliable values for the related parameters, thus helping in better and quick decision making. A smart machine also guides the user to identify faulty conditions like false alarms.

The smart machine is basically a robot supported with wheels .It is mounted with the temperature, gas and smoke sensors. Ultrasonic sensor is also connected to help the smart machine to avoid collisions with obstacles in its path The live video streaming of the monitored area is also provided by the camera setup on the mobile robot. The software and hardware involved in implementing the smart machine is achieved by Raspberry PI and Arduino Uno. A radio frequency identification module is also supported to know the exact location of smart machine in the monitoring scenario which in turn helps in narrowing down the search for a faulty component .The control of the smart machine movement is done at the user interface.

KEYWORDS: *Arduino Uno, Dependability, IOT sensors, smart machine,, RFID.*

1 .INTRODUCTION:

The implementation of Internet of Things (IoT) along with a smart machine helps in realising the IoT applications which demands a high level of reliability, due to involvement of economic and human loss. The data collected from the fixed sensors system during monitoring of a fire hazardous situation will not be able to give the accurate picture of the considered environment .The improvement of reliability of these applications is based on additional clarifying information obtained with the introduction of independent mobile smart machine.

The recent development in the robotic technology has helped human lives to become more convenient and secured. It has created a pathway to access any type of monitoring system which becomes inaccessible due to different hazardous situations like fire.

A fire detection system comprises basically a group of devices such as smoke sensor, temperature sensor, gas sensor, automated alarms, water sprinklers etc. These devices can prove to be faulty at any instant of time. The smart machine mounted with the additional sensors contributes in identifying the faulty condition to improve the dependability of the system.

The process of monitoring consists of two sections. They are the monitored environment section and the monitoring section or simply the user interface. In the monitored section, the smart machine is introduced in addition to the fixed sensors. On the smart machine all

the required sensors are installed along with the camera for live streaming and a RFID module for location detection.

2. RELATED WORK:

The values of the different parameters involved in fire detection system like temperature, heat, smoke and gas tend to deviate from its exact or original value due to which the performance of the fire detection setup degrades[7]. There is no accountability related to the adverse effects of environmental conditions over a period of time from the very first step of their installation.

The different existing systems provides additional information about the ongoing operation to create a clearer picture of the fire hazardous situation. It deals with only the collection of additional values from the installed sensors for better understanding of a situation.

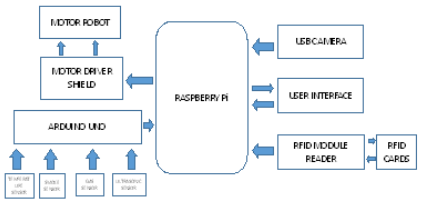
3 .PROPOSED SYSTEM:

The proposed system aims at minimizing the downtime of the system due to the occurrence of False alarms due faulty stationary sensors by introducing a mobile smart machine in the area of hazard . Error or noise free communication can be achieved to and from the monitoring base by communication with mobile robot equipped with the various sensors and a camera relying the exact scenario .It aims at reducing the down time by correctly identifying proximity area of hazard.

33.1 Hardware Description:

The main components that are decided upon are the robot chassis for the body and wheels, with a Raspberry Pi to control it .Arduino Uno microcontroller supports all the sensors mounted on the smart machine. Based on the number of sensors pertaining to fire monitoring system an alternative robot chassis have be customized that would fit in with all the components involved along with their power sources. The decision of using the Raspberry Pi was made based on the fact that it supports wireless control and the programming of Raspberry Pi is generally considered simple. The block diagram of a mobile smart machine is given in the figure below.

Block Diagram Of the Smart Machine



Microcontroller supports all the sensors mounted on the smart machine. Based on the number of sensors pertaining to fire monitoring system an alternative robot chassis have be customized that would fit in with all the components involved along with their power sources. The decision of using the Raspberry Pi was made based on the fact that it supports wireless control and the programming for Raspberry Pi is generally considered simple. The flexibility of the Raspberry Pi supports the camera for the live streaming and also for capturing and sending images.

3.2 Hardware Components

Raspberry PI:

The version 'A' being the basic version is lesser in cost and consumes less power when compared to version 'B' of Raspberry Pi.As the smart machine component are powered by batteries, version 'A' of the Raspberry Pi which consumes negligible power is preferred for the present project.

Raspberry Pi is not assigned to control the motors directly. An electronic circuit termed as motor shield is connected between the Raspberry Pi and the motors.

The camera connected with the Raspberry Pi is done in serial type and monitor if connected have a three line in which two are for the information transfer and the last one is for the clock or time impulse.

The GPIO pins are connected to the Arduino Uno microcontroller through the connecting cables. These pins retrieves the information like the parameter values that the sensors sense from the hazard area from the Arduino and delivers it to the Raspberry Pi which further pushes the sensors values on to the user display screen thus guiding the user to take a better decision based on the more reliable data acquired with the correctly done calibration sensing equipment mounted on the moving smart robot.

A RFID module is also connected to the Raspberry pi having a primary function of identifying a component, individual or a location. The process of recognition is done between the module and card without the involvement of the visible sight between the components considered. The means of communication between the source and destination is through radio waves which is shared between them by a same frequency. The most commonly used operating system for the Raspberry Pi is termed as "Raspbian Linux". Raspbian Linux is specifically prepared for the Raspberry Pi[6]. It is structure is based on the specific version of Linux known as Debian Linux.

The basic path followed to establish communication between systems with Linux OS is secure shell also termed as SSH. The secure shell communication protocol is an encrypted version thus making the communication more secure and confidential by hindering the uninvited middlemen from creating any kind of error.

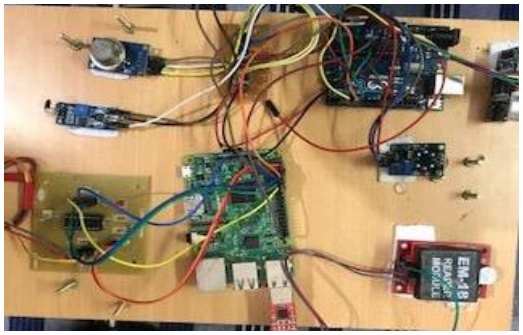
Arduino Uno:

The board of the Arduino Uno have both analog as well as digital pins involved in it. The analog pins are six in no. whereas digital are more in no. when compared to analog taking its count to fourteen. The microcontroller is programmable with a software termed as the Arduino Integrated development environment commonly termed as Arduino IDE [5]. The protocol for the interaction is the standard STK500 .The present protocol enables the microcontroller to send the sensor values through the transmitter and receiver pins. This setup between the two important hardware entities is achieved using the Universal Asynchronous Receiver or transmitter communication channel.

The microcontroller Arduino Uno is included in the hardware setup of the smart machine for retrieving the parameter values like temperature, smoke or heat which are obtained from their respective sensors .The sensors involved are connected to the microcontroller. This microcontroller collects the more reliable values obtained from the sensors mounted the hardware of the robot. The collected values are instantly transferred through the male female leads connecting the microcontroller to the Raspberry Pi .The GPIO pins of the microprocessor accumulates the parameter values in the memory before relaying it to the user interface making it available for the user/operator to analyse the true situation of the area in consideration. The different sensors namely the temperature sensor, heat sensor and the smoke sensor fall in the category of capturing the value of the parameter at that instant of time. Apart from the parameter sensing sensors the additional sensor included in the connection to the microcontroller, an Ultrasonic sensor is also in cooperated. The ultrasonic sensor is used in order to avoid any obstacle in the path of the mobile smart robot.

4. Complete setup:

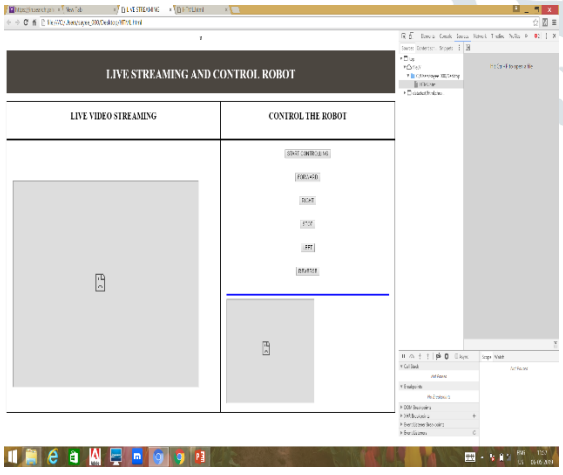
The following figure shows all the hardware components mounted on the chassis.



The Raspberry Pi is connected to the Arduino Uno microcontroller to share the incoming load of the sensors. The connection is done through the GPIO pins [6]. Along with the microcontroller, the camera for live streaming and a radio frequency identifier is also connected directly to Raspberry Pi. The data collected from these components are relayed on to the display HTML page on the user end. The motors connected to the wheels of the robot are driven by the commands received from the Raspberry Pi which acts as a receiver and interpreter of the commands issued from the web page. The communication between the HTML page and the Raspberry Pi is a two way process. The microcontroller Arduino Uno is connected with sensors related to a fire hazard situation .The values from these sensors gives the clear picture of the current area monitored.

5. Display screen:

The display or the monitoring screen at the user end is shown in figure below.



The user interface is basically a hypertext markup language page. This page is created to communicate with Raspberry Pi. The communication is a two way process .Firstly the values retrieved by the sensors and live video streaming if communicated to the display page from the Raspberry Pi .The controls for the smooth movement of the robot are done at the operator level and these commands are given to the Raspberry Pi

The display screen consists of the live video streaming from the monitored area. The motor control commands are also on the user interface for the observer to control the movement of the robot around the hazardous area. Along with the values for temperature smoke and heat the ultrasonic sensor gives out distance of an obstacle hindering the machine travel path. The radio frequency identifier module connected directly to the Raspberry Pi gives out the location of the smart machine which is displayed on the screen .The location can be referred which reference to areas orzones.

6. Conclusion

The implementation of the smart machine in a monitoring system with fixed IOT sensors can greatly help in making the system more reliable and trustworthy. The faulty values from the stationary sensors can be compensated with introduction of the mobile machine .Successful determination of a false alarm condition is expected. Reduction of response time and improvisation of the system performance is an achievable task. Minimum downtime value is aimed for different environments thus reducing any form of losses.

7. Future Scope

Counter action taken by the smart machine based on the information collected by itself from the hazardous scenario of fire without the intervention of the responsible manpower at the remote end can be classified as the promising future (for any hazard) of the proposed system.

8 .References

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