Discovery and monitoring robot based on LabVIEW

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***Abstract*— Discovery and monitoring robots have progressed to the point that it is now possible to do multitasks right over the Ethernet and the Intranet. due to the size, the cost and complex structure of these robots these is a need to alternative solution. This paper attempts to model discovery and monitoring robot, The robot responds to voice, joystick or manual commands. The manual commands can be delivered through a computer monitor or mobile phone. The system in corporate face recognition, security system, as well as, speech synthesize that delivers a brief introduction to the project once the user is authenticated. The system utilizes sensors and camera to collect data which can be disseminated via wifi or internet. This paper uses LabVIEW as the programming software and NI myRIO 1900 as the controller.**

This paper has been implemented to provide solution for the problems such as: Most of robots use radio frequency to communicate which is not cheap, The direct problem is the cost of installation and procurement of dedicated hardware., most of the robots lack good access security and most of the software take time to program it. LabVIEW program is the solution for the problem that is mentioned above, it has been invented to provide the following features: Software support web sites, compatible with a lot of low level hardware, and support image processing to do image recognition

***Index terms* — LabVIEW, myRIO1900, Skynet ,MQ2, MQ7, MQ135, L293D, results, recommendation, conculation, Reference.**

I. INTRODUCTION

Discovery and monitoring robots are very important nowadays specially after the spread of factories and with its dangers gases, also discovery in places the human can not reach or its dangers to enter it. These robots have progressed to the point that it is now possible to do multitasks right over the Ethernet and the intranet. Many companies have already deployed robots that provide both broadband capabilities and Quality of Service enabled communications. Some companies deployed intelligent robots that does not need human to control it. The goals of this robot implementation is to achieve (a) significant savings in time and operations costs(b) rapid rollout of new services.

The ability to model and simulate engineering design of discovery and monitoring robot is essential before proceeding to the engineering experimental phase. Hence discovery and monitoring robot, which composed of sensores, controller and drivers, is modelled using LabVIEW. Initially the system is subdivided into three main subsystems, namely speech recognition, image recognition and speech synthesis. The simulation results add significant understanding to the behaviour of the system model under different condition while at the same time obeying the specification. Fig 1 shows the block diagram of the paper idea.

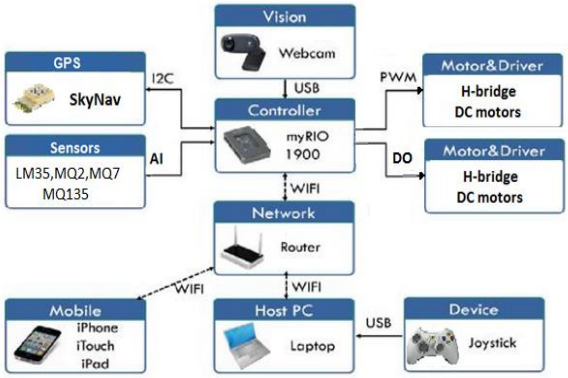

Fig 1 The block diagram

II. LABVIEW SOFTWARE

Programmers develop software applications every day in order to increase efficiency and productivity in various situations. LABVIEW, as a programming language, is a powerful tool that can be used to help achieving these goals. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphically-based programming language developed by National Instruments. LabVIEW, it is a system design platform and environment for a visual programming language from National instruments.

It is commonly used for the data acquisition, instrument control and industrial automation on variety of platforms. The dataflow programming is used as the programming language in LabVIEW.

The execution is determined by the structure of graphical block diagram (LabVIEW) source code on which the programmer connects the different function codes by drawing wires, these wires propagate variables and any node can execute as soon as all its input data become available. Since there might be the case of multiple nodes simultaneously, hence it is capable of parallel execution. LabVIEW ties the creation of user interface (front panels) into the development cycle. LabVIEW programs or routines are called virtual instruments (VI). Each of it is having three components: a block diagram, a front panel and a connector panel. The front panel is built with controls and indicators. Controls are the inputs and they allow a user to supply information to the VI. Indicators are the output, they display the results based on the inputs given to the VI. The connector panel is used to

represent the VI in the block diagrams of the other calling VI. The back panel i.e. the block diagram contains the graphical source code. All the objects which are placed on the front panel will appear as the terminals on back panel. The back panel also contains the structures and the functions which performs operation on controls and supply the data. Nodes are also connected to one another using wires. Thus VI can run as a program with front panel as user interface. The graphical approach also allows non-programmers to build programs by dragging and dropping virtual representations of lab equipment with which they are already familiar. Interfacing to devices: LabVIEW gives the support to the interfacing of devices, instruments, cameras etc. users interface to hardware either by writing the direct bus command or using high level, device specific drivers that provides native Lab VIEW function nodes for controlling the device [1].

III. IMAGE RECOGNITION

Image recognition has an important role in a wide range of applications such as biomedical imaging, security systems, scene surveillance. The ability of the human vision is excellent to match the perceived images with the already imbibed images in the brain. however, the ability to imbibe perceived images in the memory as new ones, relating them with the rest if the senses such as touch, hearing, taste or smell [2]. These human senses are extraordinary, however, they have limitations of being tired and not so fast as the computer vision.

Computer vision aids the image recognition using the projection of a group of projects in parts of collection which is easily formable and linkable [3]. However the images must be robustly match able and recognized and does not take into account unimportant external factors. Therefore the use of the computer vision for building a system for the image recognition would be helpful. The image recognition system has been created using the National Instruments LabVIEW. Face recognition is such an integral part of our lives and performed with such ease that we rare stop to consider the complexity of what is being done. It is the means by which people identify each other and so it is natural to attempt to 'teach' computers to do the same. The applications of automated face recognition are numerous: from biometric authentication; surveillance to video database indexing and searching [4].

Face recognition systems are becoming popular in biometric authentication as they are non-intrusive and not require the human cooperation. However, the recognition accuracy is still not high enough for large scale applications and it is about 20 times worse than fingerprint based systems [4]. The main reasons for it is poor performance of such systems is that the faces have a large variability and repeated presentations of the same person's face can vary because of their pose relative to the camera, the lighting conditions, and expressions[4].

Face recognition systems are examples of the general class of pattern recognition systems, and require similar components to locate and normalize the face; the extract set of features should match these to a gallery of stored examples. An essential aspect is that the extracted facial features must appear on all faces and should be detected despite any variation in the presentation: illumination, expression, changes in pose, etc. However all face recognition systems perform face detection which places a rectangular bounding box around the face or faces in the images. This can be achieved robustly in real-time [5]. Fig 2 shows the basic flow of a recognition system.

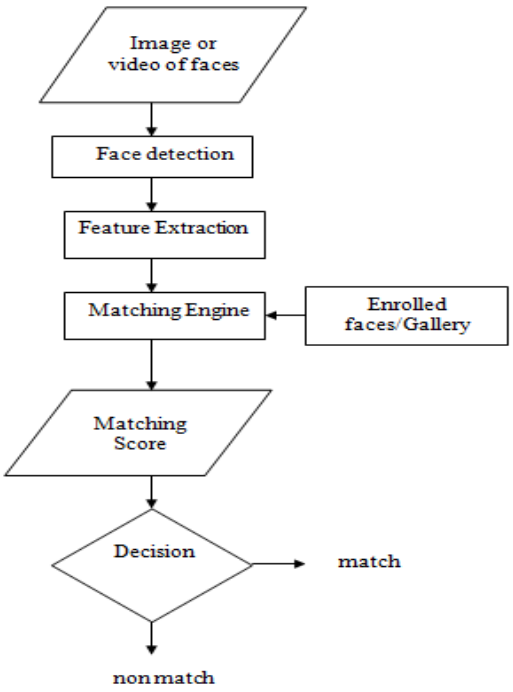

Fig 2: The basic flow of a recognition system

This paper presents the representation of the recognition of images through the process of geometric comparison. The geometric comparison is performed by comparing the image with a template through the processes of edge detection, scaling, contour matching and RGB to grayscale conversion. The software utilized is NI vision which is one of applications of the National Instrument's LabVIEW, used for the image and video processing functions.

IV. SPEECH RECOGNITION

Speech recognition applications becoming useful nowadays. Various interactive speech applications are available in the markets. But most of them are meant for and executed on the general purpose computers. With growth in the needs for embedded systems and demand for emerging embedded platforms, it is required that the speech recognition systems (SRS) are available on them. patent ductus arteriosus (PDAs)

and other handheld devices are becoming more powerful and also affordable. It has become possible to run multimedia on these devices. Speech recognition systems emerge as alternatives for such devices where typing becomes difficult to their small screen [6].

Speech recognition means talking to a computer, which recognize what we are saying, and doing this in real time. This process fundamentally functions as a pipeline that converts PCM (Pulse Code Modulation) digital audio from a sound card into recognized speech. Fig3.shows the elements of the pipeline [6]:

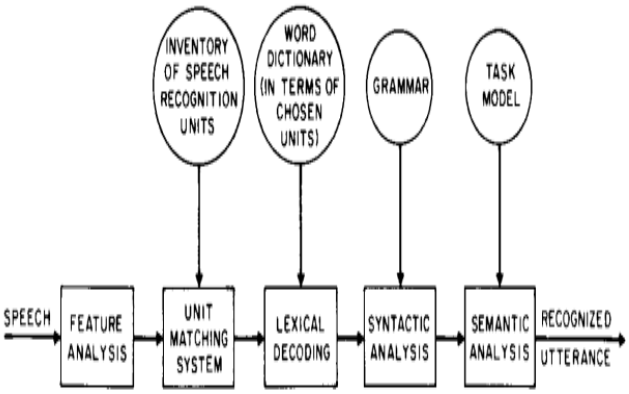

Fig 3: The block diagram of a speech recognizer

The main goal is to integrate myRIO 1900 with the SR system to control the movement of the robot . The block diagram shown below in fig 4 depicts its functioning:

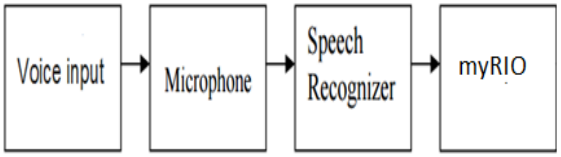

Fig 4: Block diagram for the SRS functioning integrated with Myrio.

V. SPEECH SYNTHESIS

Speech synthesis is the artificial production of human speech. Speech synthesis systems are called text-to-speech (TTS) systems referring to their ability to convert text to speech. However, systems exist that instead render symbolic linguistic representations like phonetic transcriptions into speech [7].

A text to speech processor converts the normal text into the speech. The synthesized speech can be formed by concatenating the pieces of the recorded speech that are stored in database. To create the synthetic voice output having the human voice characteristics, the synthesizer can have the model of vocal tract. The quality of synthesizer is judged by comparing it with human voice and by its ability to be understood by the user completely. A text to speech processor consists of two parts. The front part performs two major tasks. First, it converts the text into the equivalent of written out words. This is called as text normalization. The front part assigns phonetics transcriptions to each word. The process of assigning phonetic transcriptions to words is called text to phoneme conversion. The second part is called as synthesizer, it converts the text into sound. Fig 5 shows the basic block diagram of the text to speech processor [7].

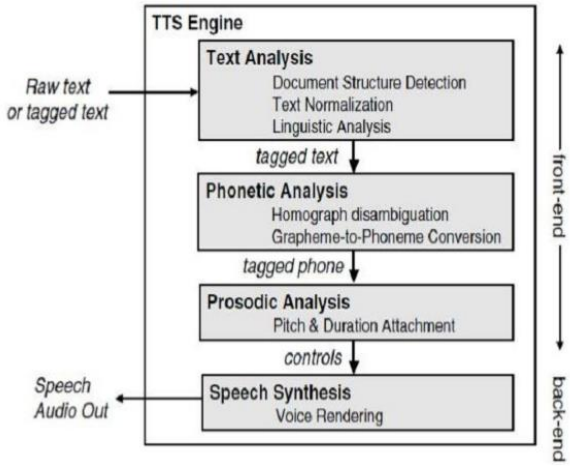

Fig 5: Block diagram of a general TTS

VI. Introduction to MYRIO 1900

The NI myRIO embedded student device that was created for students to let them experience real world engineering It features a 667 MHz dual core ARM Cortex-A9 programmable processor and a customizable Xilinx field programmable gate array (FPGA) that can be used to start developing systems and solve complicated design problems faster all in simple enclosure with a compact form factor. The NI myRIO device features the Zynq-7010 all programmable system on a chip (SoC) to unleash the power of LabVIEW software both in a realtime (RT) application and on the FPGA level. Rather than spending countless amounts of time debugging code or developing user interfaces, LabVIEW can use graphical programming paradigm to focus on constructing systems and solving design problems without the added pressure of a burdensome tool [8].

NI myRIO is a reconfigurable and reusable teaching tool that helps learn a wide variety of engineering concepts and complete design projects. The RT and FPGA capabilities along with onboard memory and built in WiFi allows to deploy applications remotely and run them easily (without computer connection). One NI mini Systems port [MSP] send

and receive signals from sensors and circuitry that needed in system and three connectors (two myRIO expansion ports [MXP]. Forty digital I/O lines with support for SPI, PWM out, quadrature encoder input, UART, and I2C, eight single ended analog inputs; two differential analog inputs; four single-ended analog outputs; and two ground-referenced analog outputs allow for connectivity to countless sensors and devices and programmatic control of systems. This all function is built in and preconfigured in the default FPGA functionality, which eliminates the need for expansion boards or shield to add utility. Fig 6 shows NI myRIO-1900 [8].

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Fig 6: myRIO 1900

VII. The SkyNAV SKM58

The SkyNav SKM58 Series is Ultra High Sensitivity and Low Power The Smart Antenna GPS Module with embedded GPS antenna enables high performance in harsh GPS visibility environments. It is based on the high performance features of the MediaTek 3329 single chip architecture, Its –165dBm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS was not possible before. The 6 pin UART connector design is the easiest and convenient solution to be embedded in a portable device and receiver like PND, GPS mouse, car holder, personal locator, speed camera detector and vehicle locator. Fig 7 illustrates the SkyNav SKM58[9].

Fig 7:The The SkyNav SKM58.

VIII. The LM35

The LM35 series are precision integrated circuit temperature sensors, which output voltage is linearly proportional to the temperature. The LM35 has an advantage over linear temperature sensors calibrated in ˚ Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4˚C at room temperature and ±3⁄4˚C over a full −55 to +150˚C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. Fig 8 illustrates LM35 .

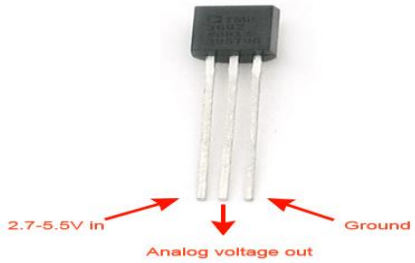

Fig 8: LM35

IX. The MQ2

Gas Sensor (MQ2) module is useful for gas leakage detecting (in home and industry). It can detect H2, LPG, CH4, CO, Alcohol, Smoke, Propane. Based on its fast response time. Measurements can be taken as soon as possible. Also the sensitivity can be adjusted by the potentiometer. Fig 9 shows gas sensor (MQ2)[10].

Fig 9: Gas Sensor(MQ2)

X. THE MQ135

Gas Sensor(MQ135) module is used in air quality control equipments for buildings / offices. Which suitable for detecting of NH3,NOx, alcohol, Benzene, smoke,CO2. Based on its fast response time. Measurements can be taken as soon as possible. Also the sensitivity can be adjusted by the potentiometer. Fig 10 shows gas sensor (MQ135) [11].

Fig 10: Gas Sensor(MQ135)

XI. THE MQ7

Sensitive material of MQ-7 gas sensor is SnO2, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensor's conductivity is more higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. The use of electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-7 gas sensor. The sensor could be used to detect different gases contains CO, it is with low cost and suitable for different application. Fig 11 shows MQ7[12].

Fig 11: MQ7

XII. DC motors

Motor is a small electronic device that can rotate, if the power supply is connected. It is a main part to make the robot moves . There are many type of DC Motor at market such as gear. DC motor, motor servo and stepper motor but in this project DC motor will be used because it can spin 360° continuously. Moreover, it is strong enough to move the trek. Fig 12 shows the DC motor. DC motor or direct current motor is the most common motor. DC motor takes direct current voltages as input and converts it into a rotational movement. DC motor basically have two wires, and can directly powered from a battery or other DC power supply. DC motor also can be power from the driver circuit that can regulate the speed and direction of the motor. DC motor has ability to turn at high revolution per minutes (RPM). The motors will operate at the voltage of 9VDC, with current 400mA.

Fig 12: DC Motor

XIII. L293D

The L293D is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heat sinking. Fig 13 shows H-bridge (l293D)[28].

Fig 13: H-bridge (l293D)

XIV. CAMERA

A camera is an optical instrument for recording images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The word camera comes from camera obscure, which means "dark chamber" and is the Latin name of the original device for projecting an image of external reality onto a flat surface. The modern photographic camera evolved from the camera obscura. The functioning of the camera is very similar to the functioning of the human eye .Fig 14 shows an electrical battery[14].

Fig 14: Camera .

XV. ROUTER

A router is a networking device that forwards data packets between computer networks. Routers perform the "traffic directing" functions on the Internet. A data packet is typically forwarded from one router to another through the networks that constitute the internetwork until it reaches its destination node [15].

A router is connected to two or more data lines from different networks (as opposed to a network switch, which connects data lines from one single network). When a data packet comes in on one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey. This creates an overlay internetwork.

Fig 15 shows Libya Telecom and Technology router [15].

Fig 15: Libya Telecom and Technology router

XVI. BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electro mechanically, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Fig 16 shows Electrical buzzer[16].

Fig 16: Electrical buzzer

XVII. JOYSTICK

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the control column, is the principal control device in the cockpit of many civilian and military aircraft, either as a center stick or side-stick. It often has supplementary switches to control various aspects of the aircraft's flight. Fig 17 shows joystick[17].

Fig 17: joystick[23]

XVIII. COMPUTER

Normal desktop or laptop computer with LABVIEW software installed on it to be used to program NI myRIO. Fig 18 illustrates Programmed PC.

Fig 18: Programmed PC

XIX. The Front panel

Fig 19 shows the front panel of LABVIEW which is the user interface.

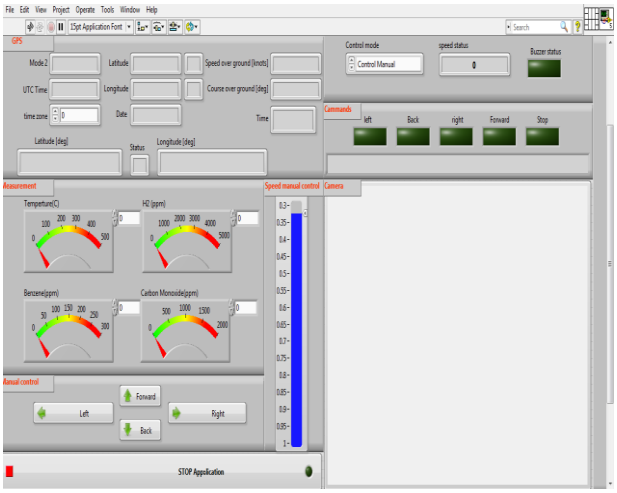

Fig 19: The Front panel

Note:

UTC= Universal Time Coordinated

PPM= Parts Per Million

XX. The photo of the complete project

Fig 20 show photo of the complete project

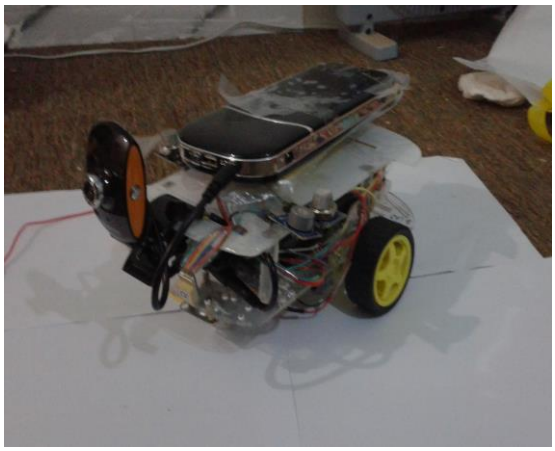

Fig 20: photo of the complete project

XXI. WORK RESULTS

This part will show the work results which divided into two parts: front panel results and analysis results.

- Front panel result as shown in the fig 21 which shows results samples of temperature, gas percentage, robot's coordinates and live video. Also shows which control mode is used (speech mode, joystick mode or manually).

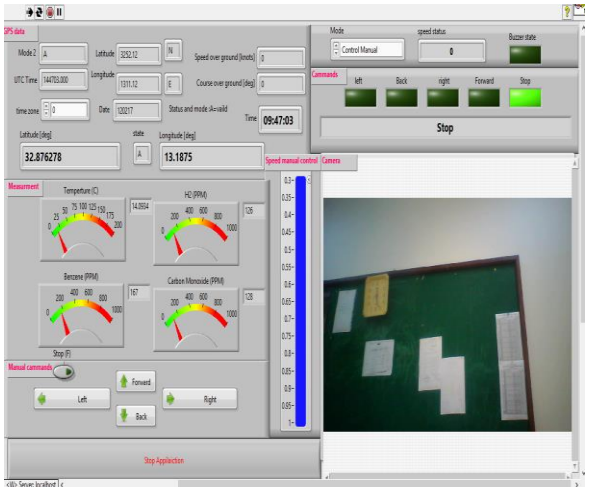

Fig 21: The Front panel with results

- analysis results: in this part will show the result that is obtained during a period of time as shown in the fig 22.

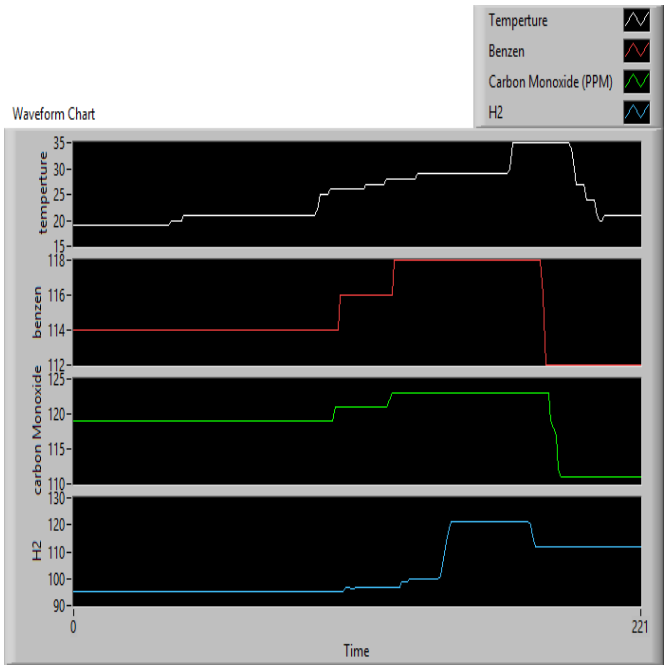

fig 22: sensors result for a period of time

It can be seen that the output of the temperature and gas sensors undershoot for the first half of signal, and the second half has an overshoot when the robot was exposed to external devise like lighter.
Also the robot has an additional feature which is the ability to save data to excel file to check at any time.
Fig 23 shows sample of excel results.

E	D	C	B	A	
Benzen(PPM)	H2(PPM))	Carbon Monoxid	Temperture(C)	time and date	1
120	124	146	17	27/04/2017 16:03	2
120	124	146	17	27/04/2017 16:03	3
117	124	142	18	27/04/2017 16:03	4
115	118	142	18	27/04/2017 16:03	5
107	118	142	17	27/04/2017 16:03	6
107	118	142	19	27/04/2017 16:03	7
107	118	133	19	27/04/2017 16:03	8
107	118	112	19	27/04/2017 16:04	9
99	114	112	18	27/04/2017 16:04	10
99	114	112	19	27/04/2017 16:04	11
99	114	112	19	27/04/2017 16:04	12

XXII. Results

In this paper it has been done a model of discovery and monitoring robot, the robot has been tested and success in the following:

1. Security system with face recognition.
2. Speech synthesize delivered a brief introduction to the project once the user is authenticated.
3. Control the speed and movement of the robot using joystick, manually, and speech. also get data from sensors and camera over WiFi.
4. Control the robot manually and get data from sensors and camera over internet.

Conclusion

There are many complex robots that depend more on hardware than software, already present in the market. So in the world of great competition between hardware and software, the software always wins in case of compatibility and the user friendliness. As they can be easily modified and updated. presented easy solution of measuring that depends more on software than hardware resulting cheaper, less size and accurate device, also possibility of improve the program by the user.

Recommendations

To sum up, the following Recommendations are written to give clear vision about the future work:

1. Change the connection to internet instead of connecting to third party server use a virtual private network (VPN).
2. Instead of NI myRIO use NI compactRIO so that Speech recognition and Speech synthesize can be done over internet.
3. Use more sensors so it can detect more gases.

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