Steering of Lab Machines Utilizing Arduino based IoT and Mobile Application

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Abstract

Currently, the world is digitized, every machine is operated and controlled through electronic smart devices. Moreover, the main objective of engineering students is to work on different machines in labs to perform various tasks experimentally. Some of the installed machines in labs are dangerous which can hurt the students as a result of any tiny mistake. Thus, Managing and controlling the lab machines are necessary to increase safety during experimental work. In this paper, the Arduino technology based on the internet of things (IoT) is evaluated experimentally for steering the lab machines using a mobile app which supports different kinds of languages and various styles of accent. This model is enabled to steer the machines with the help of wired and wireless mechanisms. The Controlling of long-distance objects by using existing power lines is also analyzed in this paper. Finally, the proposed model is compared with various current safety mechanisms to analyze the efficiency of the proposed model.

Keywords: Internet of things, Arduino, Machine steering, User safety, multiple control units.

Introduction

Internet of things (IoT) has improved the quality of life by developing and creating advancements in various technologies like tags, sensors, cellphones, etc. To achieve a goal the IoT prototype and standard allow the development of specialized hardware systems in which physical components interact with each other and work together (Patel et al., 2019; Yu, 2019). Lately to provide ease to the people in their daily new portable devices have been developed that made the connections between practical electronic with the latest electronic technologies on the IoT to provide practical function and feature to modify the quality of life of dim-sighted and weak people the academy developed many results in a particular way (Salai Thillai Thilagam et al., 2019; Shakthidhar et al., 2019). IoT has

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effective uses in the medical area, gadgets like cellphones and detection systems can be related to producing a base that provides access to health aid services and info. This approach is introduced as "Mobile Health". Mobile health can be considered as the final result of the convergence of telecommunication systems, wireless sensor networks (WSNs), and worldwide computation tools (Dhingra et al., 2019; Zhou et al., 2012). As it is known the entire globe is converting in digitization exponentially(Murthy, 2018; Naing1, 2019). Moreover, with the help of smart technologies and techniques such as Arduino, (Patil, 2018) raspberry pie, (Tedeschi et al., 2017) Internet of things (M. Rey, I. Hertzog, N. Kagami, 2015; Wadhwani, 2014), each small and large parameter can be handled and protected using physical and non-physical procedures. As result, the steering of machines with the help of the above-mentioned techniques decreases the complexity, hazards and enhances the accuracy with safety.

Furthermore, there are some modern and high valuable machines are installed in labs for testing and measuring various research projects. Hence, due to any keen careless, these machines can be disturbed which can harm the users and loss of high-value equipment. Therefore, the safety of such costly machines is important for degrading hazards and discontinuity of research projects in labs. To treat these above-discussed issues the Arduino applications based on IoT terminologies are considered a Promising Solution. So, in this paper, the steering of lab machines is analyzed using Arduino-based IoT methodology and with the help of the mobile app.

Materials and Methods

Related Work

Recently various researches have been made on the steering of machines some of them are discussed as follows In (M. Rey, I. Hertzog, N. Kagami, 2015), the authors proposed the benefits of IoT in industries it is a key enabling technology. They discuss the current state of the art of IoT and research trends and challenges. In (Wadhwani, 2014), the authors explored an ultrasonic radar system based on Arduino in which the devices are controlled with the help of the mobile application. In (Xu et al., 2014), the authors presented the survey of IoT technologies with research challenges and use for IoT. The IoT visualizes the future in which the physical and digital elements can be connected using suitable knowledge of communication technologies. In (Zhou et al., 2012), the authors discussed some basis of mobile phone application to support a cohesive and inclusive society that will come in handy in improving the quality of life of elder generations and provide some basic techniques for

researchers, designers, mobile services providers that will develop a new idea in the field. In (Li Da Xu,Wu He, 2014), the authors discussed the investigation and Design of rural Intelligent conveying Systems established on IoT. To put forward the key technologies and system architecture of detailed structural model with a recap of china's intelligent conveying System established on IoT.

In (Miorandi et al., 2012), the authors proposed a 3 phase air impurity monitoring system. The IoT gear was equipped using gas sensors, Arduino Integrated Development Environment (IDE), and a Wi-Fi component. The gear can be placed in distinct cities for the observance of air impurity. The gas sensors gather data from the air and send the data to the Arduino environment. The Arduino environment transfers the info to the server through the Wi-Fi module. The authors also highly developed an Android application known as IoT-Mobair so that applicants can get related air quality info from the cloud server. If the applicant is moving to an address, the contamination level of the whole path is expected and a cautionary is shown if the contamination level is very high and this planned system is similar to Google Traffic or the Navigation application program of Google Maps. Moreover, the air quality information can be used to portend future air quality index (AQI) levels. In (Xi Chen, Limin Sun, Hongsong Zhu, Yan Zhen, Hongbin Chen, 2012), the author's proposed activity is to build up a high-tech alert place security system with Fingerprint and Password validation to open or close the door system and also send the info. If any operation will be performed by others using GSM Technology with a smartphone. The existing method provides finer security to all kinds of houses and also this method has an economical cost so that it is affordable to all and the system is properly developed, enforced, and checked in laboratories and came to know that its operation is satisfactory.

In (D. Bandyopadhyay, J. Sen, 2011), the authors suggested a method that is supported by a microcontroller and sensors. The main points are to observe the hindrance for contact dodging and observe the target in directions front down left-right. The method is combined with the ultrasonic sensor IR sensor and Arduino Mega 2560. The model has less cost and a lightweight system design. There are 3 items by using them the distance of the object is sensed and the frame of the blind stick is also designed and then this data is fetched by the Arduino mega 2560. Whenever an object is detected the blind stick finds out the way by itself to the safe route possible. In (R. van Kranenburg, E. Anzelmo, A. Bassi, D. Caprio, S. Dodson, 2011), the authors implemented the accelerator sensor which can sense the irregularity of vehicles and vibrations when an accident has happened the system will send a signal to the controller. The

Vehicle accident sensing system using the Global system for mobile communications and Global positioning system modems is done. The sender notifications are sent to the mobile number which is provided. This monitoring system is combined with GPS receive GSM Modem an Arduino. The acquirer GPS gets the geo satellite information satellites in latitude and longitude, and the Arduino analyzes the data. The analyzed data is sent to the client using a GSM modem. The GSM modem is connected to the Node MCU, and a Heat sensor is used to sense temperature levels and escape damaging gases in the vehicle.

In (Inmaculada, 2011), the authors offered smart home automation and security strategies that they believe would succeed. During which the sensor components will be combined with the Arduino platform. The update of our smart home equipment will be transferred to a cloud platform through the wireless module, and the mobile system should be linked to the same wireless network as the smart home equipment. In order to control the client, the sensing element will be able to adapt or modify the sensors that are used. Our fingers will be used to operate the appliances via the flex sensor's input, and a magnetic sensor will strengthen the security of our doors through its input. On a cloud-based platform such as THINK SPEAK, the client may show this information fully. In order to demonstrate how the Internet of Things applications may make our lives simpler, the suggested model will be used.

Major Contributions

The project aims to control the high valuable machines of labs using advanced Arduino mechanisms based on IoT and mobile app. The major contribution of this paper is listed below.

1. The safety of high-cost machines installed in labs are investigated utilizing Arduino based IoT and mobile app application.
2. The machines are controlled in different labs experimentally using wired and wireless procedures.
3. The proposed work is performed in terms and hardware-based.
4. The mobile is designed for controlling the working of machines employing different languages and accents.

Organization of paper

The rest of the paper is organized as follows. Section 2 explains the proposed framework, Section 3 investigates the Hardware modeling, Section 4 defines the result and discussions similarly Section 5 presents the conclusion

Proposed Framework

The proposed model consists of the Hc-06 module, Arduino UNO, relay module, power source, machines to be steered, and mobile application that is the heart of this model. For the secure workflow of the lab Operator will be managing the lab machines using a mobile application with voice commands, the statement like "Turn on Machine 1" can be manually defined in the Arduino program the operator can set it up as per his desire, he can set any statement in the code any language that the google assistant can understand enabling him to operate his lab. The mobile application will have an interface in which need to be connected with the HC-06 blue tooth module first as the Arduino UNO is powered it power the relay and the Hc-06 Bluetooth module connected to it allowing a mobile application to access the Bluetooth device. As the Hc-06 is visible click on connect to Bluetooth device and after making the connection the operator will send the command through the wireless Bluetooth connection and the Arduino will receive the command using the transmitter and receiver pins.

Mobile application and Arduino UNO will be able to transfer data and the command given by the operator will be decoded by the Arduino UNO and after understanding by the micro-controller the command will be shifted to the relay module to which various machines are connected the relay will switch a load of the machine as per command allowing safe steering of machines.

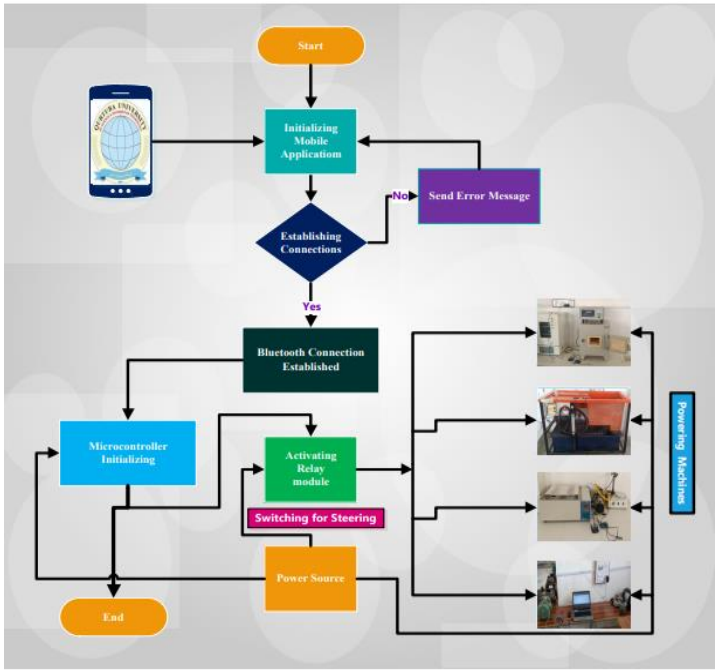


Fig. 1 Proposed model for Steering of Lab Machines

Hardware Modeling

Arduino UNO

The Arduino platform consists of a physical programmable circuit board and an integrated development environment, sometimes known as an IDE. The Arduino IDE makes learning C++ easier by using a simplified language version. The Arduino UNO is one of the most popular boards in the Arduino family, and it is a fantastic option for the average user to experiment with. The Arduino board is programmed via the printer's USB interface connected to the Arduino IDE. This connector may also be used to provide power to the board. With the help of an AC to DC converter, you can power the Arduino board. The power supply source for the components linked to these pins is activated when they are utilized as output pins.

In the case of digital pins used as output pins, they may provide up to 40mA of current at 5v, which is more than enough to illuminate an LED. When this switch is pressed, it sends a logical pulse to the reset pin of the microcontroller, which causes the programmed to be re-loaded and executed from the beginning. It might be valuable when the code does not repeat, and the user wants to test it several times. An oscillator made of quartz crystal that ticks 16 million times per second. For every tick, the microcontroller executes a single operation, such as addition, subtraction,

and so on. While being used as an output, these pins work as a power supply source for the components attached to them, and while being used as an input, they act as a reader for the signals received from the components connected to them.

In the case of digital pins used as output pins, they may provide up to 40mA of current at 5v, which is more than enough to illuminate an LED. Figure 7 shows the Arduino UNO microcontroller, which handles all of the steering settings.

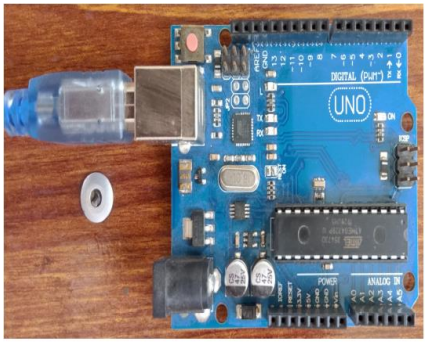


Fig. 2 Arduino UNO Micro-controller

Bluetooth Module HC-06

HC-06 connects to the Arduino through your transmitter and receiver pins (through which serial communication takes place), so, to start a Bluetooth terminal app is needed, which is similar to your serial window on the Arduino IDE only difference is that this is wireless. Through the Bluetooth terminal, you can send/receive data (once our devices have been paired) the same way you would on the serial monitor.

Fig 3 introduces the Bluetooth module that is used for the connectivity with the Arduino UNO module.

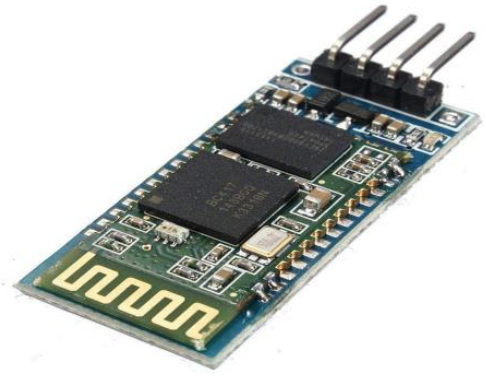


Fig. 3 HC-06 Bluetooth Module

Mobile application

The Mobile application is the controlling graphical user interface (GUI) which will allow the user to control the steering by the user using voice command and the machine can be controlled by using google assistant and the steering will be done as connectivity is established. The user can set the language of operation and perform the smart steering.

Fig. 4 Mobile Application GUI for Smart

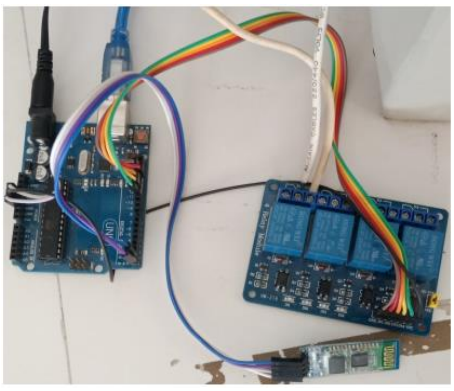
Relay module

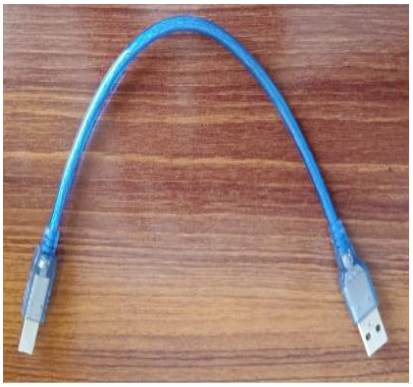
The relay module has built-in relays which are electromagnetically controlled switches. The main purpose is to make the user able to control high power voltage operation at a low power switch. The electrically isolated control switching is done. Also controlling and switching sections are kept away from each other and the module has its voltage and current ratings. The Terminals of the coil control the switch. The voltage applied to get the coil into working it makes it an electromagnet switch. Its base activates the switch by attracting the switch armature and the Common Terminal commonly open Terminal and the Normally Closed Terminal which create the switch contacts. How the relay operates depends upon the user and the program. When the relay is not turned on the common section is attached to the normally closed section. When the coil is turned on the common terminal is swapped toward the normally open terminal of the relay module. Fig 5 introduces the relay module connected to the machine that needs to be steered using the mobile application.

Fig. 5 Relay module

Results and Discussion

The performance of the proposed model is analyzed practically for different labs and costly machines. Fig 6 shows the interface of the Arduino Bluetooth module and Arduino. Fig 7 shows the USB 2.0 A/B connecting Cable used for connecting Arduino UNO to the laptop for coding purposes. Fig 8 shows different categories of jumper wires used for





connection of modules. Fig 9 introduce the 9v volt for powering the module Figs 10-14 introduce the installation of IoT based steering proposed model implemented on different machines in labs, where high voltage machines are controlled by modern IoT system.

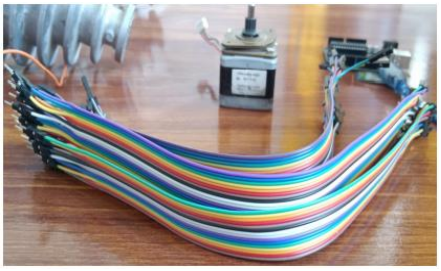


Fig. 8 Connecting Cables for Modules.

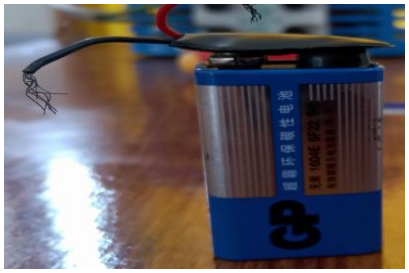


Fig. 9 9v Battery Source for Powering Arduino.

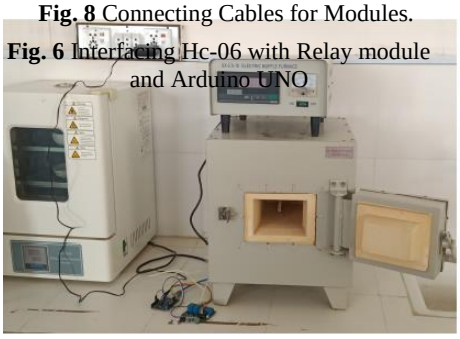


Fig. 6 Interfacing Hc-06 with Relay module and Arduino UNO

Fig. 7 USB 2.0 A/B Connecting Cable.

Fig. 10 Steering of Lab Machine 1

Fig. 11 Steering of Lab Machine 2

Fig. 12 Steering of Lab Machine 3

Fig. 13 Steering of Lab Machine 4

Conclusion

The research paper performs efficient work on costly machine steering using a mobile phone application that will control the steering of lab machines using different language as the instructor can set any language in the system program allowing the smart steering to provide an environment where the student can work safely.

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