iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VI **Month of publication:** June 2017

DOI:

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Implementation of an IOT Based Smart Chair

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Abstract: We present the implementation of a Smart IoT Chair system for Internet of Things (IoT) that combines an embedded device and IOT server. The proposed Smart IoT Chair records and visualizes user's posture through a smart phone application and with the help of servo motor mechanism the users correct their unbalanced posture. It uses custom designed sensors ADXl335 accelerometer sensor, and also Node MCU and Bluetooth communication to transmit data with low-power consumption. We implemented a prototype of Smart IoT chair combing ADXL335 accelerometer, servo motors,adafruit 16channel servo driver, an Arduino, a Bluetooth module and a Node MCU. Preliminary results show that our Smart IoT Chair combined with our case-study smartphone application can accurately detect various user postures and automatically corrects the posture after some predefined delay with help of servo motor mechanism. Node MCU will keep updating data position of the chair to the adafruit server.
Keywords: ADXl335 3-axis accelerometer sensor, servo motor, Bluetooth, Node MCU, Adafruit server

I. INTRODUCTION

Recently, various systems and applications utilizing IoT technology have been developed to help people in addressing issues that occur in our everyday life. Most people today spend more than half of the day on chairs for various purposes such as studying, driving, or working. For this reason, modern people are afflicted with waist disease such as lumbar disc, hip twisting and scoliosis, which rarely occurred in the past. For this reason, many hospitals which specialize in treating spines have been established nowadays.

In this paper we use the servo motor which automatically corrects the position of the chair, users will be able to check their own sitting habits and increase efficacy in posture correction through feedback. Furthermore, this capability can be utilized for various purposes such as medical analysis, development of new medical equipment or chair, an office management service, and mobile games for exercise which can be applied to patients during rehabilitation. In our work, a Smart IoT Chair which supplements this limitation makes users sit correctly with recognition of their own current state by providing intuitive and visualized data in real time to Smartphone application. We can decrease back and hip pain caused by sitting for a long time through dispersing the pressure on the back and hip by dimidiating automatically correcting posture of a person sitting on the chair. Here we using free available open source Adafruit server to update the position of the person sitting on the chair IO includes client libraries that wrap our REST and MQTT APIs. IoT server will be triggered by the IFTTT server i. e it send the ON OF commands packets to the Node MCU ESP8266. Adafruit IO is a system that makes data useful. Our focus is on ease of use, and allowing simple data connections with little programming required

II. OBJECTIVE

The Smart IoT Chair implemented by this study can be used in various fields. First application area that we are targeting is in games for leisure or for posture calibration. With these games, the goal would be to correct user's posture while enjoying games by directing appropriate sitting position opposite to the user's usual habit based on collected data.

In addition, it can analyze sitting pattern of each individual and give user medical advices or stimulus such as vibration or sound. Furthermore, other Smart devices can also be created by combining other furniture with this IoT device. (e.g., a bed which analyzes sleeping pattern, a sofa or kitchen chair that provides custom services). As an immediate future work, we plan to precisely quantify the sensing ranges of our custom designed sensors, conduct thorough evaluation, deploy the chairs at a larger scale, and employ a gateway to collect posture data from large number of chairs.

III. LITERATURE SURVEY

There are a few prior work that combines a chair with the IoT technology. The work in [1] and [2] study Smart Chair system which measures user's pulse or blood pressure automatically while sitting on a chair. However, our work differs with those since our goal

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

is to help user by correcting their posture, not by pulse or blood pressure. In addition, previous studies can transmit and receive data only through one-to-one connection to a single device. In contrast, since power consumption is a very important issue in IoT systems [3][4], our system uses Node MCU and Bluetooth 4.0 that can to operate with lower power consumption, and our Smartphone application is designed to be capable of receiving data from multiple chairs (e.g. in offices or hospitals) concurrently. Similar to this study, another research analyzed user's sitting posture using a Smart Chair [5]. They tried to measure user's sitting posture through sensing motions and states of a waist and a pelvis, but they did not provision for providing additional services such as correcting user's posture.

In our work, a Smart IoT Chair which supplements this limitation makes users sit correctly with recognition of their own current state by providing intuitive and visualized data in real time to Smartphone application. SHESOP is an intelligent health system designed to monitor health condition of the user and provide information from the data saved in system. SHESOP integrate three subsystems such as web, mobile and wearable devices. One of implementation SHESOP system applied on smart chair in car aims to monitor heart rate and stress level of the driver. Implementation of the system in the car will provide convenience to the driver to take a decision on the way by the condition of the driver's heart health. Electronic stethoscope utilizes a microphone and an electronic circuit as an amplifier and signal conversion of acoustic signals into digital. To facilitate physicians in analyzing the status of the heart, the output can be visualized in the form of spectrum and stored into a digital audio format. Results of analyzed heart sounds can determine the condition of the driver's heart health and stress levels using HRV method.

IV. PROPOSED DESIGN METHODOLOGY

A. Block Diagram

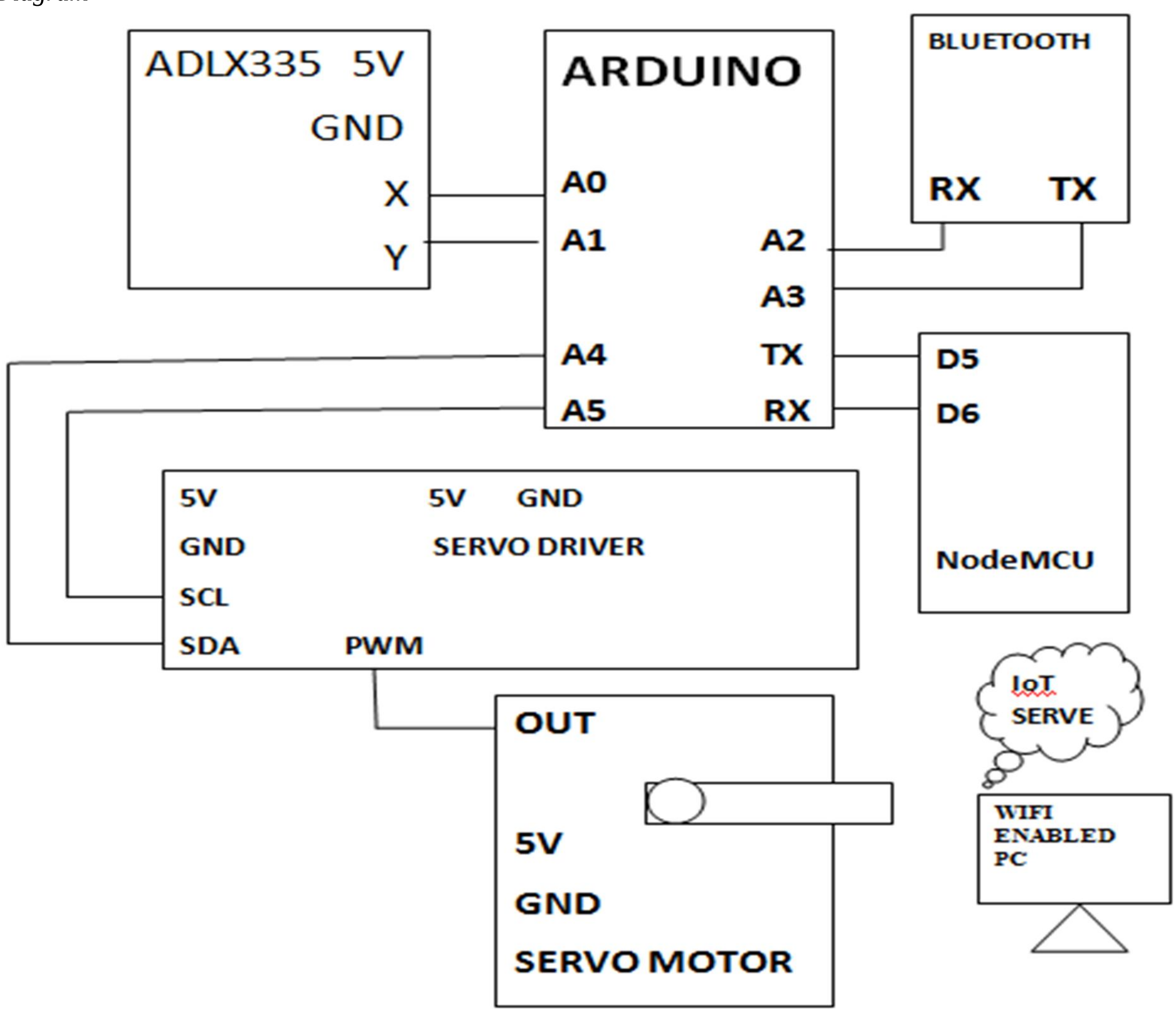
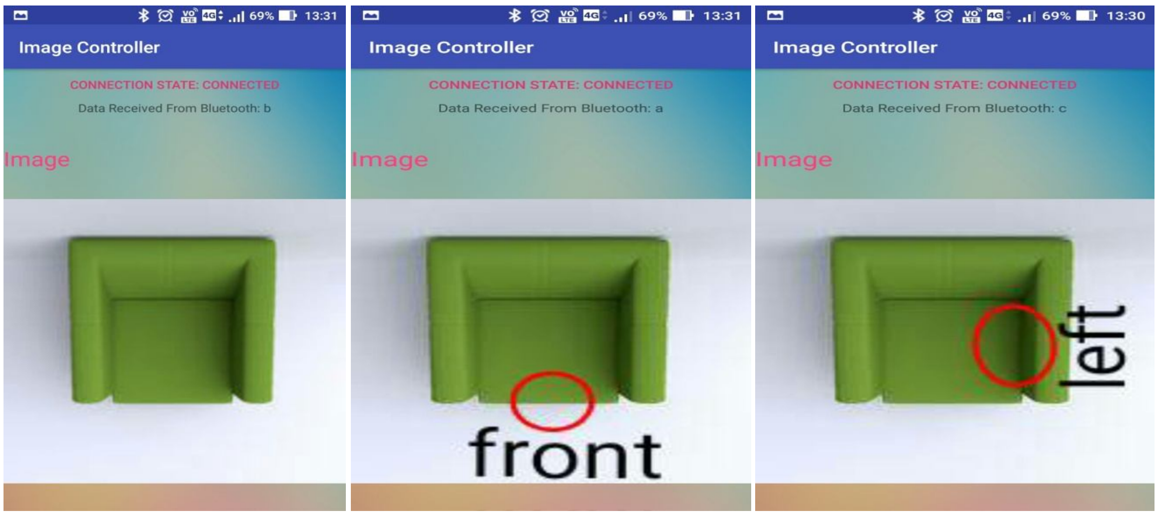


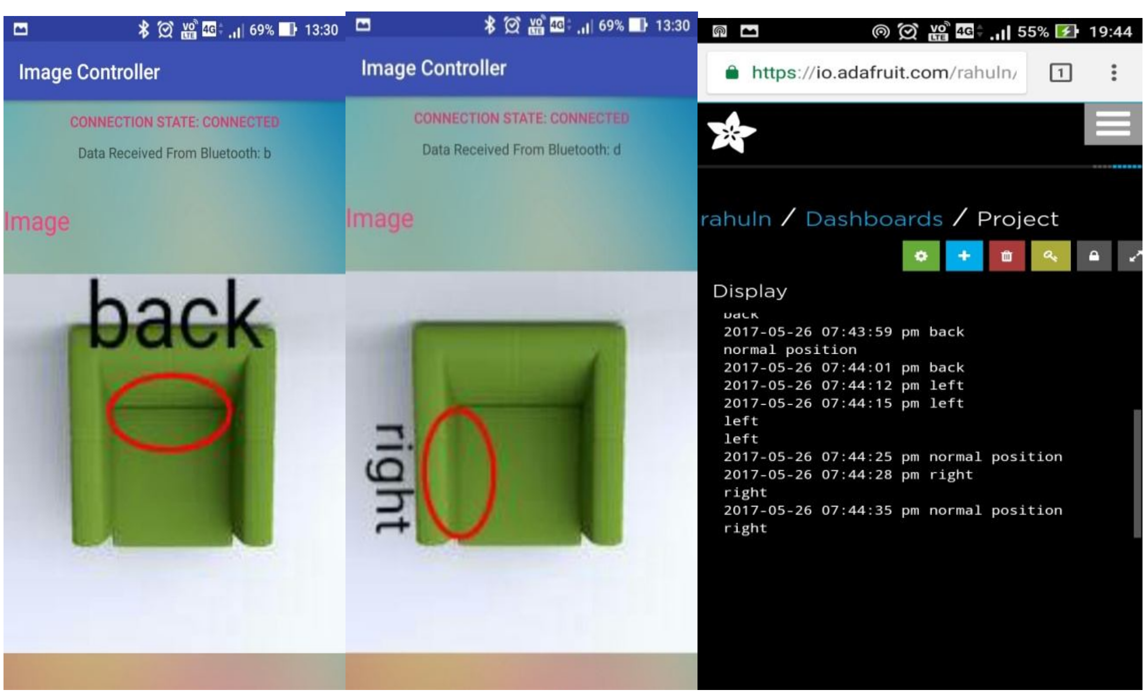
Figure 1. Overview of smart chair system

Figure 1 presents an overview of our proposed Smart IoT Chair system. An embedded component servo motor which helps auto correction of posture and IOT sever. Then, the embedded IoT device sends measured sensor data to a Smartphone and a server, using Bluetooth 4.0 communication and node MCU. Finally, both the server and the smartphone receive, processes, and visualize the posture data sent by the Smart IoT Chair in real-time. An ADXL335 can be used to analyze the pattern of an individual or groups and send analyzed data to the server by processing data received from a number of Smart IoT Chairs. As an alternative, smartphone can also act as a gateway and process and transmit data to the server. In our prototype implementation, an Arduino uno is used because it is intuitive and simple to program and it is also easy enough to be interface of a Smart IoT Chair. Furthermore, it uses custom designed sensors designed as a result of extensive experiments of this study, which we will present in the following subsections.

V. RESULTS



(1)Normal position (2) Tilt front (3) Tilt left



(4)Tilt back (5) Tilt right (6) Adafruit server

Fig.8 Images of Bluetooth application and Adafruit server

To verify whether the implemented device and the application operate properly, we performed experiments for each posture. Figure 10 shows screenshots of the application for each posture. The photograhs shows user's actual sitting posture shows data through visualization. In the visualization, red colored circles represent the four user's posture represented by the tilting posture with help of ADXL335 accelerometer sensor placed in the chair itself. As you can see from our preliminary case study, the Smart IoT Chair application expresses user's sitting posture in the form of tilt and pressure correctly as we i ntended. It means the t ilt are measured reliably on the Smart IoT Chair.later it has been updated to Adafruit server to users will be able to check their own sitting habits and increase efficacy in posture correction through feedback. Furthermore, this capability can be utilized for various purposes such as medical analysis, development of new medical equipment or chair, an office management service, and mobile games for exercise which can be applied to patients during rehabilitation.

VI. CONCLUSION

Through this study, we developed a Smart IoT Chair system combining an embedded IoT device and Adafruit server. During the research, we discovered the limitations of the existing commercial sensors and overcame these problems by developing custom designed sensors. Our system is designed to transmit and receive data with low power consumption by adaptively applying both the node MCU and Bluetooth 4.0 connection mode communication. As a result, the Smart IoT Chair can analyze users sitting posture with accuracy. Finally, we introduced application areas in which Smart IoT Chair systems and services can be developed in the foreseeable future.

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