Internet of Things Based Smart Classroom

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Abstract— This paper gives a detailed information on the Internet of Things Based Smart Classroom which creates a digital environment for studying. It consists of three modules which performs three different tasks. Each module consists of a processing module which acts as a Processing unit. These processing units are coded using Python Programming. The first module used is an automatic garbage collector which is fully autonomous. It is incorporated with an Arduino Board with some sensors connected to it. The second module used here is a notification display module. It is a display device which can be used to display notices on the upcoming events. It consists of LCD display screen and GSM module on Arduino board which can receive messages and help them display on the notice board. The third is a facial recognition based attendance system. It comprises of wireless camera connected to the computer. The processing unit is programmed to recognize faces of students it comes in contact with and update it into the database. It records entry and exit of students and marks the attendance into the database.

Keywords: IoT, Wireless Camera Based Detection, Automated Floor Cleaning, Digital Notification Display Board, Autonomous, Reduced Human Work

I. INTRODUCTION

The implementation of smart classroom project can reduce the amount of manual works done in a classroom to an extent. Anyway, some of the tasks need to be performed manually by the operator. These tasks can include operating the automatic garbage collector module. The first module which is automatic garbage collector consists of an Arduino board and number of sensors to assist the module to perform the tasks coded into them. The main functionality of this module is to find the correct path for movement and clean the dirt and collect the garbage. This is operated autonomously by the Arduino board coded to control its movement. The second module is a digital notification display board which consists of the Arduino board and display device. The display device is LCD screen which displays the message sent by the server computer which is received by the GSM module in the Arduino board and this Arduino Board which acts as a processing unit converts the received message and processes it to display on the LCD screen. The third module is a facial recognition software that marks the attendance of the students entering the class. It consists of a computer CPU which acts as a processing unit. A wireless digital camera is connected which can take images of person entering and exiting the class. The attendance of the student is marked into the database. The identification of the student is done with the help of LBPH classifier.

II. RELATED WORK

In this section, The authors Vishnu Priya Reddy Enugala, Sukanya Vuppala proposed a scheme for an autonomous classroom. In modern world, interlinking technologies are playing major role in smart world with smart devices and has impact on computer science. In this Internet of Things (IoT) is defined as the uniquely identifiable objects and their virtual representation is internet like structure, that is gaining ground in the Computer Science field. IoT is making our lives easier with the advent of smart thermostats, medical wearable devices, connected vending machines and others. In IoT important research area is Resource Management Systems (RMS). The valuable proportion is to treat physical chairs as "smart" devices, which can report their occupancy, user information, and duration of presence of the student to the cloud and mobile application. The smart chairs is made of interconnected smart devices consisting of reflection sensors, RFID readers, wireless communication capabilities, and useful mobile application serve as a powerful tool for instructors and other stakeholders. In this research paper we implement a complete smart classroom system consisting of smart chairs, cloud storage with smart attendance recording system of the students.

III. METHODOLOGY

A. Proposed System

1) Automatic Floor Cleaning Module:

This module consists of an Arduino Board and sensors which gives signals to the board. This signals are in turn interpreted by the Arduino Board and it will control the movement of the cleaning robot based on the functions provided in the program. This program is written in Arduino software which is used for controlling Arduino based projects. The ultrasonic sensor is placed vertically above the robot body at a height of 7-8 cm. This sensor is connected to a servo motor which assists in 180 degree rotation of the sensor thereby allowing to measure the distance around its surroundings. It is coded to detect an obstacle at a range of 15cm and as soon as it finds out stop the movement of the robot. The movement of robot is achieved using motors which are connected to 4 bridge motor driver. If there is an obstacle at a range of 15 cm from the sensor it will stop the movement of robots thereby looking left and right. If any of the distance is greater than 15 cm it moves to that direction. Another component is a DC motor which is connected directly to the Arduino board. A cleaning object like brush is attached to this DC motor which is placed at the back of the robot. This motor will rotate continuously irrespective of the distances measured by the ultrasonic sensor.

2) Digital Notification Display Board:

The main components used here are Arduino board, LCD screen and GSM module. The processing unit here is the

Arduino board which is coded to display the received messages. The message which is required to be displayed on the screen as class notice is sent by the server computer to the GSM module which will receive the message and the received message is processed by the Arduino board. The message received is then converted by the processing unit (Arduino Board) to displayable format and is displayed on the screen.

3) Facial Recognition Based Attendance Software:

This module consists of a wireless camera connected to a processing unit. The wireless camera will be placed at an appropriate entry point of the class. This will recognize the faces of the person entering the class and store the name of the person along with the date and time the person entered the classroom. Initially, the images of person those who are likely to enter the class (here students of the class) is provided as training data along with the name of the person as the directory name. The file operation function of python will help extract the name of the directory and recognize image files in that particular directory. With the help of Computer Vision certain image extraction techniques are used to find the faces in that image and recognize them. Numpy is used for simplifying the mathematical operations using certain functions and manipulating the arrays. Here histogram patterns for comparison will be stored in arrays which will be manipulated by the numpy. The python program coded here is for face identification and face recognition. Identification and recognition basically both does the same job, the only difference is that one is used for learning and the other is used for real time detection. Both the files use 'haar cascade' and 'LBPH classifier' for face recognition. The haar cascade classifier is used to detect the faces from a given image. The LBPH face recognizer extracts the histogram patterns of the detected face and stores it in an 'yml' file. This is the training data for the face recognizer. The face identification file saves the training data as an 'yml' file and it is read by the face recognizer for real time face recognition. The face that is captured by the camera will be converted to grayscale by computer vision as it is in BGR format. The LBP value is obtained using the nearest neighbour algorithm which align an arbitrary number of neighbours on a circle with a variable radius. The histogram patterns of the LBP value of the region from the real time image captured by the camera is stored and compared with the training data. This is done with the help of numpy which is used for numeric calculations of python arrays and numbers. Euclidean distance is used to compute the distance between histogram pattern values of the training and testing data. The one with closest values during the comparison is taken and the corresponding name of that person is specified. This will be provided as output along with the date and time the person entered the class.

B. System Architecture

1) Automatic Floor Cleaning Module:

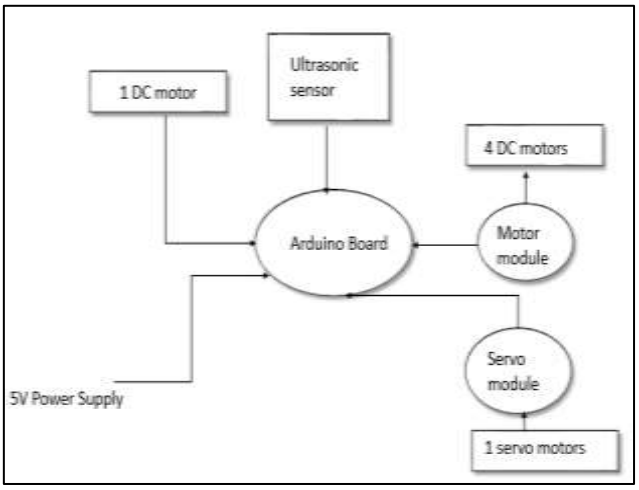

Fig. 1: Automatic floor cleaning module system architecture

2) Facial Recognition Based Attendance System:

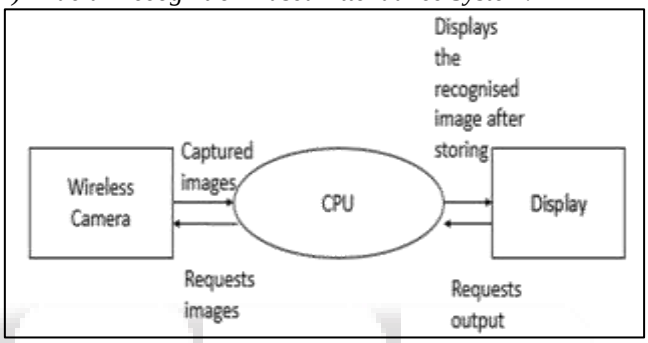

Fig. 2: Facial Recognition Based Attendance System

3) Digital Notification Display Board:

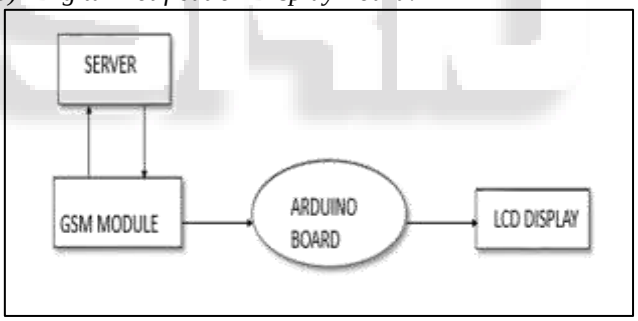

Fig. 3: Digital Notification Display Board

C. System Requirements

1) Hardware Specifications

- Arduino board
- Ultrasonic sensors
- Servo motors
- Motor drivers
- LCD screen

2) Software Specifications

- Python
- Arduino-nightly
- OS – Windows

IV. RESULTS AND CONCLUSION

The IoT based smart classroom helps reduce the work done manually by humans. Automatic floor cleaning module can reduce the amount of human work done in cleaning the class room to an extent. The solid waste collector at the front –

bottom collects the solid waste and floors can be kept clean by the brush which rotates continuously at the back of the module. The facial recognition software reduces the work of teachers and save their time by marking attendance automatically on recognition of face. It also marks the time and date the person entered the class thereby reducing the confusion and malpractices of proxy attendances. The digital display board can reduce human work by displaying the notice thereby reducing the human work of reading the notice manually. These modules can help reduce the work of humans to an extent.

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