Open Loop Automated Baby Cradle Using Dobot Magician and C#

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ABSTRACT

Purpose: *We are all busy, especially those responsible for family expenditure. We have lots of pressure in our workspace. Some employees are still doing work from home. Family being converted into an office as well. The problem arises when our small kids cry during a scheduled meeting. Sometimes need someone who can swing the baby's cradle. Here we demonstrated an automated baby cradle which is useful when our baby cries. We can put our kids into the robotic cradle and engage in other work. When the baby cries, we trigger the run button from our working PC/Laptop, and the cradle starts to swing automatically. Here we used Dobot Magician for this purpose, a famous robot in the education and research sector due to its cost-effectiveness. To drive the robot, we developed an application in C#. It is a small program that is used to swing the cradle. Here we move the robot by the program. So we can change the program quickly, so our sweetheart feels more comfortable inside the cradle. The entire project source code is available on Github. Anyone downloading the project can integrate, test, and continue further improvement.*

Design/Methodology/Approach: *In our research, we used the Dobot magician robot to swing the cradle. One support-like stick is connected between the robot and the cradle to push the cradle. The robot is driven by the program written inside the programming area. The original API is a little bit programming specific. So we provided intermediate programming space to write code as our understandable language. The complete application is developed using the C# language under Microsoft visual studio 2022. We used the vendor-provided dynamic link library to send the command to the robot to reduce development time.*

Findings/Result: *We can integrate the Dobot magician robot into our custom project after developing the complete system. The movement pattern can be changed by changing the program, which may be used for different task execution utilizing the robot. The IDE can also be used for other robots, like UARM metal, a 3D printer, etc. Under the code, any robot can be operated using this interface. It has a programming interface, as well as a command-line interface. We can test, debug and experiment as well.*

Originality/Value: *We created our application in C#, a modern, easy and flexible language. The IDE has lots of scope for experiments. The program has very easy to understand. We use the robot to swing the cradle for flexibility in nature. We can change the swings pattern by changing the parameter value, which is impossible in fixed monotonous movement. This can give us a unique feature than most other available procedures to swing the cradle.*

Paper Type: *Experimental-based Research.*

Keywords: Robotic cradle, Dobot Magician API integration, Automated Baby cradle, Smart robotic IDE.

1. INTRODUCTION :

We are now in the modern era where we are mainly engaged in arranging the cost of living. In this race, the most suffering candidate is our child in different forms. When our baby is crying, sometimes we are unable to pick them up on our lap or swing the cradle for a while. In this scenario, we need some system to swing the cradle. We know that robots or automated systems are used anywhere inside

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the industries. And a little bit in the domestic fields. In this paper, we developed a robot-based automatic cradle. The dobot magician robot is used here. It is the most popular robot in the education and research field. It is low cost compared to the other robot on the market. Its accuracy and repeatability are moderately acceptable. The vendor provides API and SDK for different platforms to make life easy. We are using C# API here. Their C# demo application is built using WPF (windows presentation foundation). We convert it into a C# desktop form application. We made the application more user-friendly using some UI control like buttons, a textbox, and a combo box. Our robotic cradle is an open-loop system. It is just oscillating the cradle taking without feedback. We kept it as simple as possible for installation. The cradle is moved as the robotic arms move. Here changing the programming parameter, we can change the pattern of swings in the cradle so the baby feels more comfortable as we move them manually.

2. RELATED WORKS :

Goyal, Misha et al. developed an automated baby cradle that swings when a baby cries. It detects the baby's voice and swings until the baby cires [1]. TP Patekar et al. developed an automatic baby cradle that can automatically move when the baby is disturbed. They use a miniature voice capture microphone to capture the baby's cries and advance the cradle, and some small portable arrangement is attached to the cradle [2]. Queries et al. developed a project where the cradle swings for five minutes when the baby cries and sends an SMS to the mother if the baby's crying does not stop within a specific time. They integrate two sensors to sense the temperature and moisture of the baby towel [3]. Bhatnagar et al. worked on indigenous E-cradle. They provide a wet sensor to sense the wets of the baby's mattress. It will help to protect cold from damp bed. If the bed wet is triggered, the alarm to the mother's attention [4]. Lokar et al. developed an intelligent baby cradle. They add an image processing subsystem. It takes images, processes, and compares to detect the baby crying. If the baby cries through mobile, send a notification to the mother or nurse in charge in the hospital [5-10].

3. OBJECTIVES :

This research aims to provide practical information on how to move a baby cradle automatically. Using a robot, we can do it quickly. Here we used a cost-effective robot which is most popular. Not only the baby cradle, following this procedure, we can also engage the robot for the monotonous and repetitive tasks, which have the prospect of automating. We can save valuable time by doing another innovative or non-repetitive job. The application interface has easy-to-program features. Even a little bit of knowledge about the robot can automate any task. Researchers working on automating some human activity can find some helpful information.

4. APPROACH AND METHODOLOGY :

Figure 4.1 depicts our system's complete block diagram. The figure describes that our application runs the three main subsystems: the robot, baby cradle, and PC. In the PC application, the main UI thread is responsible for integrating all functionalities. The main UI thread has four subsystems. They are command-line interfaces, Command parsers, programming interfaces, and robot command handlers.

4.1 Command Line Interface:
In our user interface, we provided one combo box to send the command to the robotic arm by typing. If we click the combo box, it will popup the command set we integrated with this application. This combo box has an auto-completion feature. If we type some command, the popup will show the list of the command associated with the letters. After entering the command, press the enter key to process further.

4.2 Command parser:
The command parser subsystem is the next step of command input. The input of the command parser comes in two ways. One from the input box, i.e., combo box. And other from the programming interface, which runs sequentially using dedicated timer control. It scans line by line and sends the string to the variable to parse. Receiving the command as a string, this subsystem parses into some parameters, creates a new structure according to calling methods, and fills it. And then fetch the API command sending the structure as the function parameter.

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4.3 Programming Interface:

The programming interface has beautiful features where commands are executed repetitively in a loop. There is a dedicated timer to run the program. Pressing the run button, the timer will start and scan line by line. We are reading the row content and sending it to the robot. To stop the program execution, press the stop button. We can add the command into the programming interface in two ways. One, click the row and type the command directly into the line. Two, We can insert a command from the history list. Select the command and enter, then add it to the programming list. To manage the program interface, below there are "insert," "delete," "Up," and "DN" buttons. We can also execute a single command. Select the row and press the "SEND" button. Only it will perform. The "Load" button loads the program from the saved file. "Save" is used to keep the recently modified program. And "Save As" saves the currently opened file with another name.

Fig. 1: Block diagram of the proposed system
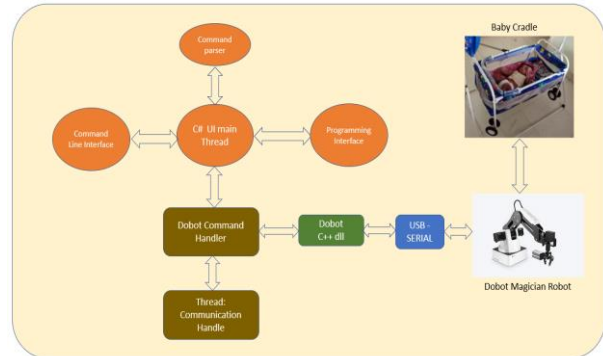
4.4 Command History List:

The command history shows the previously used command. One copy is pushed to the history list when we send the command through the command terminal. The last command is pushed at the top. It has the ability to send the command text to the programming interface. Select the command already used from the history list and press enter. The context will show in the programming list. The history list is saved automatically when the application close.

4.5 Dobot Command Handler:

This subsystem is fully responsible for sending the command to the robot and receiving the response from the robot. The response is displayed inside the message box.

4.6 Baby Cradle:

The baby cradle is any cradle we can use. It is connected to the robot through some support. Figure 2 depicts the connection between the robot and cradle. Due to the open-loop arrangement, it has no feedback path. It makes us a little bit cost-effective. We can change the program, so our baby feels more naturally moving.

Fig. 2: Cradle-Robot Connection

4.7 Github File List:

After downloading the project zip file from Github, we will see some files depicted in figure 3. The top file "Baby_Cradle_Swing.prg" is a small code for cradle swings. We can add and modify parameter values. The "C#_project.zip" is the C# project file. It was developed with visual studio 2022. The DobotAPI-main.zip" is the vendor-provided demo code for C# developper. The "Robotic Baby Cradle.mp4" is the demo video, and the "dobot-api-en.pdf" is the API list provided by the vendor.
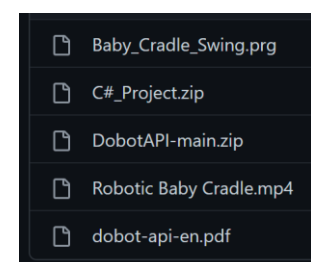

Fig. 3: Github file list

5. EXPERIMENT :

Figure 4 depicts the user interface of the application. In the previous section, we understand the details of the system's architecture. Now we do some practical work. The procedure is as below:-

5.1 Connect robot with PC:

First, we need to connect the robot with a PC or computer. There are two cables with the robot. One is a USB cable, and the other is a power cable. At first, provide power to the robot. Then, connect the USB cable. Press the Power button. The blue light should glow; else, check the power.
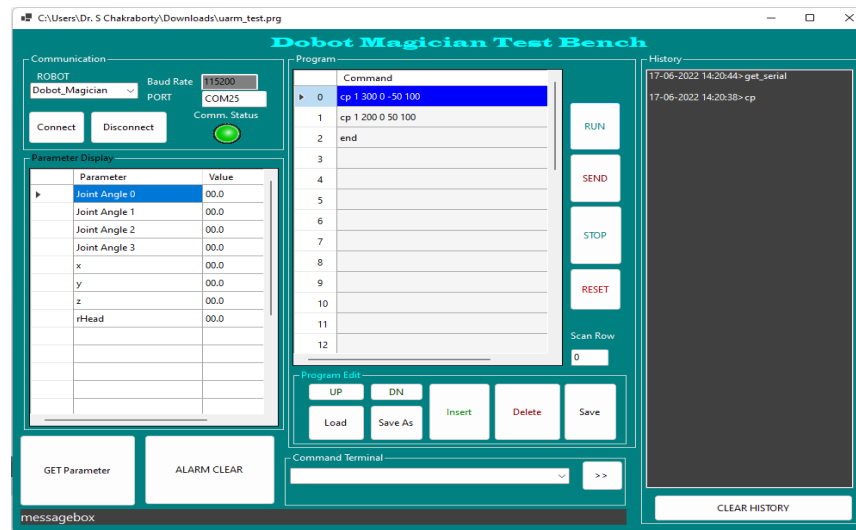
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Fig. 4: Application Programming Interface

5.2 Download application:

Download the project file from Github. The link is available in recommend section. Unzip it. Run the Project.exe file, available in C#_Project\Project\bin\Debug\net6.0-windows bin\debug\Project.exe. It will open an application like figure 4.

5.3 Run the application:

It is from the windows device manager, note the assigned port for the robot. It looks like COM9, COM2, etc., then enters the "PORT" text box. The baud rate is fixed. We cannot change it because it is hardcoded inside the robot motherboard. Press the connect button. The green led shows connection is successful. Else the red will LED glow. After the successful link, press the LOAD button and select the "baby cradle. prg" program, available from the downloaded project folder. The program will load inside the programming interface. If we press the run button, the robot should move.

5.4 Connect Cradle:

If the robot moves fine, press the stop button. Now we can connect the cradle. Currently, our system is ready. When the baby cries inside the ongoing meeting, press the run button. To stop the cradle any time, press the "stop" button." That's it.

6. RECOMMENDATIONS :

➢ The project code is available from:
  https://github.com/sudipchakraborty/OpenLoop_Baby_Cradle
➢ For Dobot Magician robot API integration, http://www.dobot.it/wp-content/uploads/2018/03/dobot-api-en.pdf
➢ Visual Studio 2022 community edition can be downloaded from:
  https://visualstudio.microsoft.com/downloads/
➢ Using the API list, we can integrate more commands into the application.
➢ The developed application has lots of scope for bug fixing and new features.

7. CONCLUSION :

Through this research, we developed an automated swings digital cradle for our loving babies for their comfort. For this purpose, we use a low-cost dobot magician robot. We created the application using their provided API and dll. It is customizable, and we can add value to this application. After proper programming, we can also move the cradle from any PC and the internet. This research work is also helpful who want to integrate and run the robot from their custom application. The robot-provided API is incorporated here. So it will be helpful for them.

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