COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

AGILE PROJECT MANAGEMENT SYSTEM

TureON

Turning Machine Visualization

Software Requirements Specification Document

Submitted to

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1. Introduction

The purpose of this document is to outline the software requirements for the Turing Machine Visualization project. A Turing machine is an abstract computational model that performs computations by reading and writing to an infinite tape. Turing machines provide a powerful computational model for solving problems in computer science and testing the limits of computation — are there problems that we simply cannot solve? Turing machines are similar to finite automata/finite state machines but have the advantage of unlimited memory. They are capable of simulating common computers; a problem that a common computer can solve (given enough memory) will also be solvable using a Turing machine, and vice versa. Turing machines were invented by the esteemed computer scientist Alan Turing in 1936.

The Turing Machine Visualization project is a web application project named as "TureON" which is designed to help individuals understand the inner workings of a Turing machine. It visualizes the concept of Theory of Computation through Turing Machines. We plan to implement a website so that users can create an account after which a platform will be provided for them where they can create, save and update their own Turing machines for various problems. Through this project we aim to simplify the learning exercise by enriching the knowledge level of students on an abstract topic like the Turing Machine through visualization and graphical representation.

2. Purpose

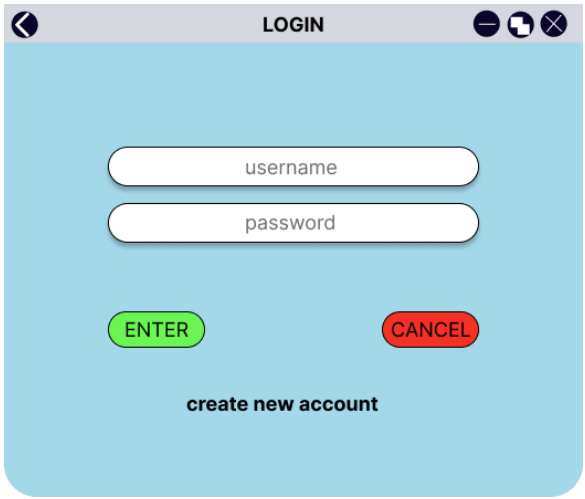
The purpose of the project is to enhance teaching, learning experience in a computer science perspective, especially on abstract area like Turing machine. The project provide a platform for both computer science students and anyone with logical intuitions to synthesize their own solution to various problems in the domain of computer science through Turing Machines. As it does not require any prior knowledge of coding, anyone can use the website and enjoy the learning process as, the website makes learning a fun process like drawing. The Project will also benefit educators as they can easily convey such abstract topics to students through visual cues and boost the understanding level of each student without tedious effort on blackboard. The computer science enthusiast can use the website to create Turing Machines for complex problems which can be accessed by the community and thereby revolutionize the teaching-learning paradigm.

As the website provides a facility to save your projects you can refresh your memory just before the exam or if in case you forgot the logic behind the Turing machine. The website also provides options to comment on each state in the Turing machine thereby helping you to document, why you created this state. If the website span among the community, you can access the content of the experts from the comfort of your home.

3. Website Overview

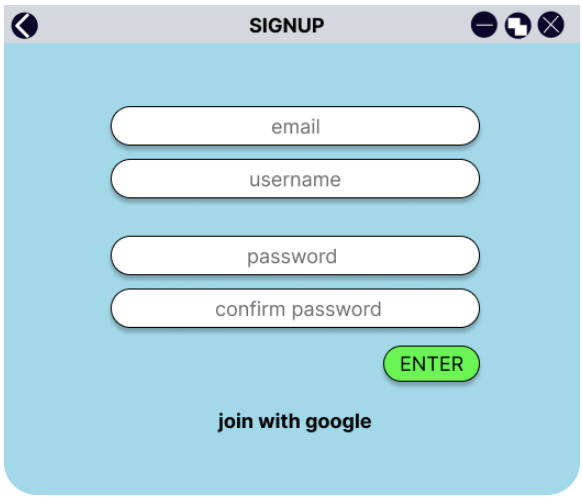
- Login Page:

  Turing Machine Visualization Project begins from the Login Page where the user is provided with the facility to log in to their account using a username and password. New users are provided with a link to move on to the signup page.



- Sign Up Page:

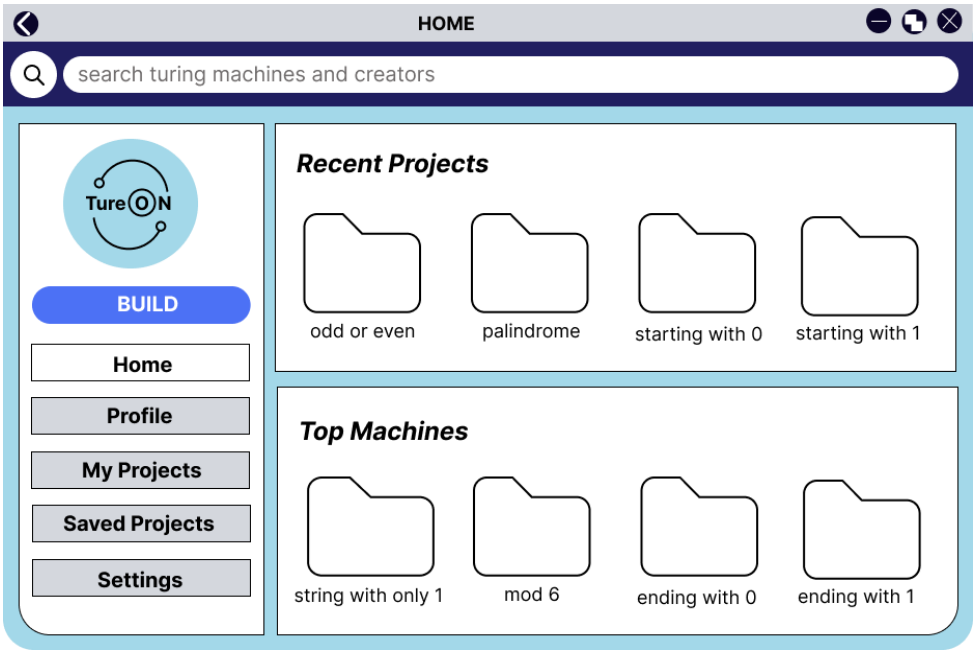
  New Users can build projects by creating an account on the website either by providing the pieces of information like username, email id, and password or using their google account.



- Home Page:

  Logged-in users are taken to the Home Page. It is partitioned into quarters which
  include Search Panel, Dashboard, Recent Projects and top machines.

  - Search Panel: Users can search for different Turing Machines for various purposes and creators by entering the problem and username of the creator respectively.
  - Dashboard: The dashboard contains functionalities namely BUILD, Profile, My Projects, Saved Projects, and Settings. The build functionality helps to create a new project. The rest of the dashboard severs as a navigation
    platform for the users to reach out to different pages.
    - ❖ BUILD: This facilitates navigation to the project-building page. The users on reaching the project building page are equipped with the facilities to build a Turing Machine.
    - ❖ Profile: It navigates the user to the profile page where the primary details of the user can be displayed and edited as per requirement.
    - ❖ My Projects: It lists out various user projects which they have created or worked on.
    - ❖ Saved Projects: It moves the user to the page with the list of projects of other users which they have saved for future reference
  - Recent Projects: The recent works of the user are listed in chronological order.
  - Top Machines: Globally Most viewed projects are displayed here.



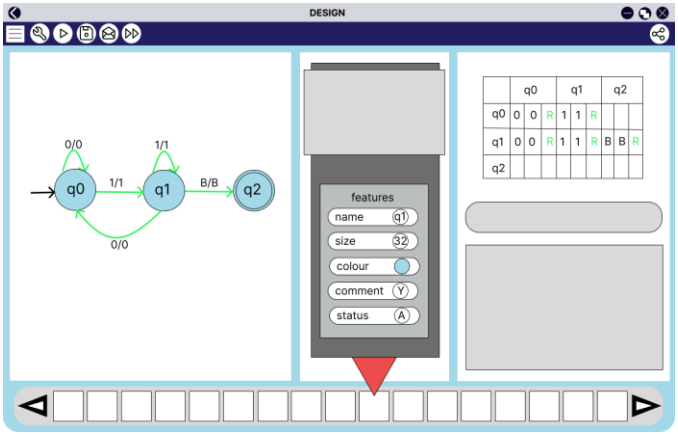
- Build Project Page:

  The entire page is divided into quintuple which includes Accessory panel, Drawing Panel, Machine Panel, Matrix panel, Input Panel

  - Accessory Panel: It includes the Navigation tool, Toolbox, Run Key, Save Key, Open Key, Test run key.
    - ❖ Navigation Tool: Help to navigate through different pages
    - ❖ Toolbox: It has various tools for building the graphical representation of the Turing Machine, such as Start, Final, and Intermediate state, and also Transition arrows.
    - ❖ Run Key: Enables the user to run the built Turing machine on user inputs.
    - ❖ Save Key: The user can save the fully or partially built Turing machine for future references
    - ❖ Open Key: Saved projects can be opened using this option.
    - ❖ Test run Key: Helps the user to trial run the automata with random inputs from the language to test the accuracy of the Turing Machine.
  - Drawing Panel: It provides a canvas to draw the graphical representation of the Turing machine by drag and press method using the functionalities in the toolbox.
  - Machine Panel: It has twin purposes, while building the project it serves as an arena to display state functionalities and during

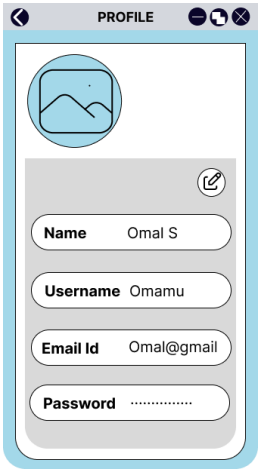
running the machine it serves as the head part of the Turing Machine and helps to visualize the flow of the machine through different states during various inputs.

- Matrix Panel: It contains the matrix representation of the Turing machine displaying various state transitions with input symbols, directions, and rewrite symbol.
- Input Panel: It contains a graphical tape representation that accepts input from the user, user can enter input in each tape cell and use arrows to roll the tape.

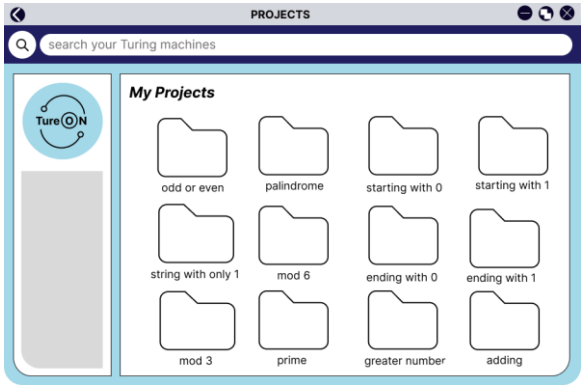


- Profile Page:

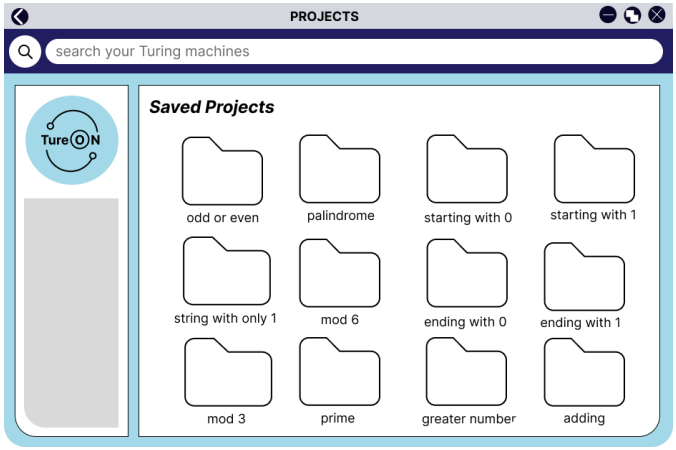
The profile page is provided detailed information about the user which includes name, email id, password, profile pics, etc, and their editing options. It also has information about the creators which the user is following .



- My Projects Page:
  Contains all the projects created by the user.



- Saved Projects:
  Contains projects which are saved by the user, that is created by other users.



4. User Functionalities

- Building a Project :
  In the building project page the user is provided with the functionalities to create a Turing Machine. The user can use tools from the toolbox to draw an automata by select and click method. Different states and transitions can be added to the diagram. Based on the diagram the matrix will be created in the matrix panel. Each state and transition can be costomized as per the requirement of the user. Comment can be added to each state and transition for future reference.
- Testing a Project:

There is also facility for auto genetrated input for testing the project. In each stage of working user can check if the created states are working properly by running the Turing machine from that state using the testing option.

- Running a Project:
  The user can run a project, based om user input or test run it on default inputs provided by the system. During running the project the actual working of the Turing machine is stimulated, each state and transition is highlighted accordingly and the head movement and present tape is displayed continuously. This feature allows the user to properly visualize the working behind a Turing machine.
- Saving the Project:
  The User can save fully or partially completed projects for future reference or completion respectively. They can save the project publicly or privately and thereby altering permission, on who all can view the project, by saving the project privately only the user can access the project but by saving publicly others can also see and run the project but cannot alter it.
- Sharing the Project:
  The User can share the project with other creators who can access the project as per the mode specified by the user. They can also access the project by going to the users account by searching the user name or the project name.
- Search the Projects:
  Creators and educators can search for Turing Machines on various problems through search panel provided in the home Page where they can access public projects provided by different users.

5. Technology Used

Our Project is a Turing Machine Visualization website that will be developed using Node.js for the backend and React for the frontend. We have chosen to implement this website using the M E R N architecture, which stands for MongoDB, Express, React and Node- are the four key technologies involved in the development process.

- MongoDB – Database
- React – Client-Side Framework
- Node – Premier JavaScript web server
- Express – Node.js web framework

6. Wire Frames