

For a proposal-based open collaborative system, a bug tracking system with a bug market is required.

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Abstract—

Bugs and defect have been in existence since software development has started. Each time an application is made, it is obvious that some bugs or defects can be encountered. This is where, Bug Tracking System comes into effect. A Bug Tracking System is a utility software which helps to track, monitor and manage the bugs reported or generated in the system [2]. This tool allows us to report, approve and assign bugs fixing task to the user with the help of tickets. Tickets will carry detailed information about what the bug is, what impact it may have on the system and how quickly the bug has to be fixed. Based on the ticket status, Bug Tracking activity takes place. Whereas, collaboration is also one of the major features of Bug Tracking System. Generally, internal team collaborate with each other and fix the bug. Meanwhile, if the team is small or led by single handed, there may be a case to ask for public collaborators. Bug Market will help the public collaborators to find various bug listed by various team and individuals. Anyone who is willing to collaborate will send a proposal to the project maintainers and based on shortlisting of proposals, suitable developer can be invited to collaborate with the internal team and fix the bug. Therefore, this type of open public collaboration via Bug Market will make Bug Tracking System more engaging and effective to track, manage and fix the bug.

I. INTRODUCTION

Bugs are occurred when the application doesn't work as it is designed. Bugs are generally the technical issues that arises and which needs to be fixed for running the system effectively. Bug Tracking System is an application software which keeps tracks of bugs which are reported and identified by developers, team and customers. This type of system helps to track, manage and monitor any bugs collaboratively [8]. Bug Tracking System generally have reporting, assigning and approving features which helps the internal teams to distribute the reported bugs among the team members. Whereas, collaboration is one of the major concerns in Bug Tracking System. Users are granted some permissions and based on those permissions, some actions were allowed and allocated. A typical Bug Tracking System helps to ensure whether each reported or generated bug is fixed on time based on different priority and severity levels. Using the internal tools, developer will work on bug fixing and will update the status of bug fixing through the ticket.

II. OBJECTIVES OF RESEARCH

A. To encourage individual and group of developers to track bugs generated/reported in their personal and group projects

When developers make any personal project on their own efforts, it is obvious that they will be encountered with many bugs during the project development cycle. When they are involved in project assigned by company, they will be given bug tracking tool. But while making their own projects, developers are not habitual of using bug tracking application. This Bug Tracking System will provide tools to the individual developer for monitoring and tracking the bug thought the project development lifecycle. Developer can also show how bugs were generated and how he/she is able to effectively monitor and track the bug as well as how he/she is able to solve that particular bug or issue. This will help developer to effectively showcase how he/she encountered the bug in the application made by them and what strategies he/she has followed to fix the system issues.

B. To create BugMarket for promoting open collaborations between companies, teams and individual developers.

Bug Tracking System comes with different features which helps to manage, monitor and tracks the bugs effectively. This proposed system not only focuses on building the core features of Bug Tracking System but also devoted to promote open collaborations between companies, teams and individual developers. This open collaboration can be achieved via Bug Market.

Bug Market is the open portal where all the individuals, teams and companies can post the Bugs for allowing others developers or team of developers to collaborate and fix the bug. One who is willing to fix the bug of others should need to write a proposal and send it to the project maintainers. Once the proposal is accepted, the individual will be added to the internal team and he/she shall work collaboratively for bug fixing. Bug Market will contain list of bugs posted by different teams and developers in different languages, frameworks and libraries. This will create an ecosystem where one can browse the bug details which are public and send a proposal to fix it. Based on the performance of contributors, they shall be provided some points for collaborations. These points will help them to showcase their level of work and the understanding on a particular technology on the resume and portfolio websites.

III. LITERATURE REVIEW

A. Issues and Challenges in Bug Tracking System

The other bug tracking tools available in the market are mostly paid for basic features as well these tools have complex system which are not comfortable with the developers. Many developers complain that these tools have confusing user interface and it takes a lot of time to get familiar with the system workflow. Whereas, collaboration between developers is really a challenging task for any bug tracking system. Many popular bug tracking tools lacks good collaboration between developers while fixing the bugs.

B. Trends on Bug Tracking System

In the past, spreadsheets were used to record the bug details. But now, due to the advancement of technologies, a separate system application is made and all the bug details are stored in database. Storing the bug details electronically made the bug tracking more efficient and faster. Nowadays, the bug tracking tools are embedded in the project management software, since bug tracking and bug fixing is also a part of software development cycle. Whereas, there are some bug trackers which are only used for bug tracking activity [9]. These application helps the small-scale developers and team to get the benefit of bug tracking tool. Therefore, bug tracking system can be used as a single-handed application or it can be added as the extra functionalities in project management software.

C. Research on Similar Topics

Various researches have been done in the past in the field of bug tracking system. The main agenda of these research were to ease the bug tracking activity and help to create an application which can be easily used to track, monitor and manage the bug tracking activity. Whereas, collaboration is also one of the hot topics among the researchers and bug tracking applications [10]. Study of advancement of real-time communication has been made and but there are few researches done focusing on how public collaborators can be invited in the bug fixing activity [7]. This research paper is mainly focused on the role of Bug Market for promoting open collaborative system. The bug market is intended to help the small team of developers to participate in bug fixing activity of any team or individual's project.

IV. RESULTS AND PROPOSED SYSTEM ARCHITECTURE

A. System Development Environment

The following table shows what programming languages, backend and frontend frameworks, libraries can be used to build a web-based Bug Tracking System.

Programming Language	Python 3
Backend Framework	Django 3
Frontend library	Bootstrap 4

Database	Postgres
Other	Git, Github, Django Guardian

B. Purposed System Architecture

The system architecture is designed in such a way that any individual, team or even a company can register in the application. There are basically 5 different types of entities which will handle and manage the flow of individual and group of developers inside team and company. They are Company, Products, Team, Designation and User. There exists One-to-many relationships between Company and Products, Products and Team, Team and Designation, Designation and User. Each entity has some attributes which will store required data as shown in this figure.

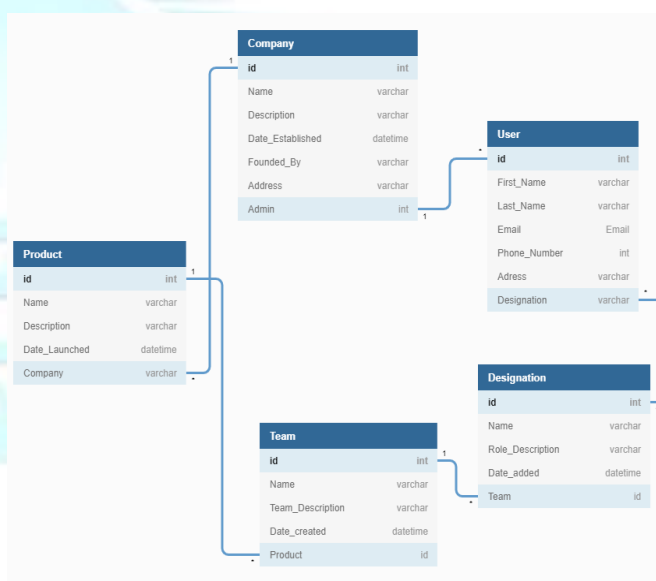


Figure: System Components Database Design

C. Permission System Implementation

Permissions helps to allows the user to perform what they are allocated to do. In this purposed system, admin will be granted all the available permissions. Admin will be responsible to handle which user can perform and take part in which features and services. Sometimes, there may be large number of users and to manage each of their permissions can be a difficult task. To automate this type of granting of permissions, object level permission can be used [6]. While creating each designation, some permissions can be granted to each objects of designation. In this way, each designation object stored in the database, will have their own custom permissions. While performing large number of user entries, admin can just assign a designation to the user and all the permissions granted to that designation object can be transferred automatically to that user on the backend side. This will help admin to easily monitor and manage the user permissions and their actions.

D. Bug Tracking Workflow

Basically, all the activities of bug tracking start with the bug reporting system. In the bug reporting system, the user/customer is expected to submit a ticket. Ticket will contain all the information related to the bug identified by the user/customer [3]. A typical ticket will generally store following information.

1. **Ticket Number:** A ticket number is a random number allocated to a ticket each time when a ticket is submitted by the user using the reporting feature. This type of random number can be generated simply by concatenating the current time stamp and any random number. This type of pattern will be relevant, easy to understand and can be tracked using the same number.
2. **Title:** The ticket title will contain small descriptions of the bug identified. The title is usually expected to be in one or two sentences not more than 100 words.
3. **Ticket Description:** The ticket description will store the detailed information about the bug. User are expected to enter complete information about the bug in this section. Description can be around 200-1000 words.
4. **Screenshot:** Screenshot can also be uploaded as it can be counted as good proof regarding the existence of the bug.
5. **Ticket Status:** Ticket Status will represent the current state of the ticket. There are 8 different types of ticket status. They are Submitted, Rejected, Approved and Unassigned, Approved and Assigned, Postponed, Resolved, Closed and Duplicate.

Ticket Status	Description
Submitted	Ticket is successfully submitted to the project maintainers.
Rejected	Ticket is irrelevant, invalid and doesn't point to any bug in the system
Approved and Unassigned	Bug is identified based on the submitted ticket and team will be soon allocated for bug fixing.
Approved and Assigned	Ticket is assigned to the internal team for the bug fixing.
Postponed	Bug fixing is postponed due to some reasons.
Resolved	Bug is fixed by the internal team but final solutions is yet to be verified.
Closed	Bug is completely fixed, solution is verified.
Duplicate	Similar ticket found in the database.

6. **Severity Level:** Severity level is the degree of impact of bug on the system/application [1]. It helps

to describe how serious the bug is and how badly it effects the functionalities of the system. There are generally 4 types of severity level used as described in the table.

Severity Level	Description
Low	Bug won't cause major effect on the system.
Minor	Bug will affect the system but the system functionalities will not break.
Major	Bug will highly affect the system and the system may crash.
Critical	The effect of bug on system is so high that system has to be shut-down.

7. **Priority Level:** Priority Level is the order or the urgency in which the project maintainers should fix the issue [1]. It shows how quickly someone should react and work on bug fixing. There are generally 4 types of priority level used as described in the table.

Priority Level	Description
Low	The bug can be fixed later once others bugs/issues are resolved.
Medium	The bug needs to fixed but some delays can be done.
High	The bug needs to be fixed immediately.

8. **Public View:** The public view is a boolean value which states who can see the ticket. A normal ticket with public view status set to False states that only internal team or users who are granted permissions can react to the ticket. But if the public view is set to True, then the ticket will be listed in the Bug Market. All the tickets which are listed in Bug Market will accept proposal from user who are authenticated. They will be allowed to view the ticket details and write a proposal to the project maintainers asking for bug fixing and collaboration.

In this way, the major part of bug tracking is done with the help of a single tickets. Once the ticket status is changed to approved and assigned, some users will be granted permissions to view the details of the bug and work on the fixing using their internal tool. Time to time, the ticket status will be updated so that proper monitoring can be done. Once the bug is fixed and solution is verified and ticket status can be updated to closed and it will no longer accept any updating the tickets or its associated components.

E. Bug Market Role in Open Collaborative System

Bug Market is an open portal where all the tickets whose public view is set to True, are visible. Tickets which are listed in Bug Market, will accept proposal from any developers which are authenticated. Tickets listed to bug market will simply state that the internal team or project maintainers wants some public collaborations to fix the bug. This bug can be of any type, any severity level and any priority level. Developers who are willing to collaborate and contribute will send a proposal to the internal team/ project maintainers. The proposal will contain how qualified the developer is, fixing the bug and what strategies the developer will implement to fix the bug. Once, the proposal is accepted, the user can be added to the internal team and can collaborate with the team members using the existing tool/ services used by the team. Once the bug is fixed, user shall be given some points for sending the proposal and working for the bug fixing. These points will help the user to showcase their capabilities and understanding towards any particular technology or system in the resume and various other professional networking platforms. This type of Proposal Based Collaborative System in Bug Market will encourage young developers to come and explore what challenges they might face in software development lifecycle and how effectively they can showcase their capabilities to fix the bug/issue.

F. Bug Tracking LifeCycle

From the bug reporting to ticket generation to bug fixing, there are many stages of Bug Tracking [5] and the lifecycle of a typical submitted ticket can be studied in the following diagram.

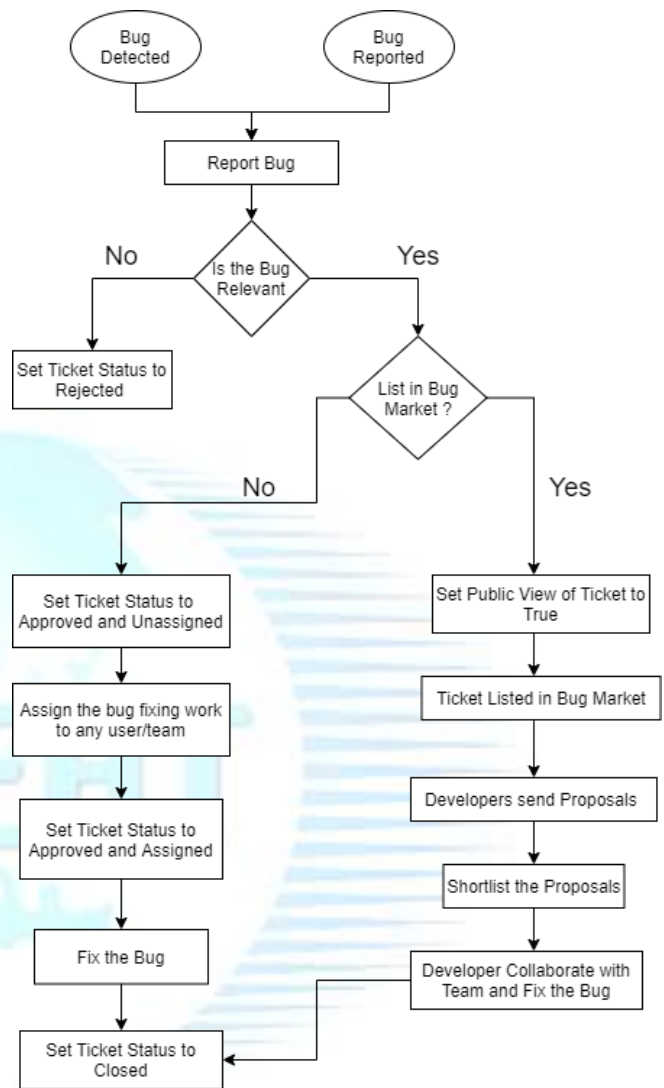


Figure: Bug Tracking Lifecycle Flowchart

G. Testing

Software Testing is a method using which we can verify whether the application built can meet the software requirements or not [4]. It helps to ensure whether each functionalities of the application are working correctly as it is designed. We can test this Django application using unit-test library of Python [12]. It is a standard library which helps to test applications built using Python.

V. FURTHER STUDY

There has been various number of researches conducted on the domain of Bug Tracking System. The research was intended to introduce a Collaborative System so that the small-scale team and developers can get benefit from this type of collaborative. Whereas, the introduction of Bug Market in Bug Tracking System is expected to promote open collaborative system where any user who have certain skills and good understanding of any technologies can contribute and engage with small- and large-scale team working on that particular domain. Moreover, various other features can be

studied and implemented in Bug Tracking System for any individual who is willing to work in this type of Bug Tracking System. Some of those features are as follows:

- Real time communication between team members.
- Github API integrations with the system for automating the Bug Tracking Task in the public and private repositories.
- Notifications for Critical and High Priority Labeled Tickets via Email, SMS and Social Media Platforms.

VI. FUTURE SCOPE

Since, the outcome of this purposed system shall be a web application built using Django Backend Framework. But one who wants to use this application in mobile devices as an android or IOS application are unable to do. Therefore, REST API can be built so that it will opens the path for mobile application development for this project [11]. As well as one can also make React.js application and provide more interactive and single page user experience to the user.

VII. CONCLUSION

Bug Tracking System helps companies, team and the individual to track, manage the bugs encountered on their system. This type of system is heavily used in software industries where large number of users are actively involved in bug fixing. The application not only allows internal team to track the bugs but also allows them to release the tickets to the public asking for public collaboration. The Collaborative System of this application is intended to promote open

collaborative system among developers who are interested to collaborate and fix the bug. The purposed system will help every single developer, team and companies to take benefit of Bug Tracking Tool with Collaborative System via Bug Market.

VIII. REFERENCES

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