Implement Design Thinking Methodology for Prototyping a Smart Farm Application to Monitor, Control and view real-time data Analytics through SAP BUILD

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Abstract **- Agriculture being the backbone of many growing nations. Government and Individual estates, cultivated with cash crops and plantations with high dollar value are always in risk of being stolen, destroyed by wild animals and prone to forest fires attacks. The forest resources being nurtured for better return on investment needs frequent monitoring all day through one or more security personnel along with updating daily labor activities and farm produce of the crops, which is done manually and verification on the same is done on weekly basis. The loss of vegetative produce cannot be pointed towards an Individual, group or wild animals to the Police Station or Forest Department without prior evidence like some kind of a snapshot or video recording that needs to be submitted for further process. Prevention is better than cure and an application, which would integrate technology, to resolve this is need of the hour for Agriculturist's.**

I. INTRODUCTION

In the past, design has most often occurred fairly far downstream in the development process and has focused on making new products aesthetically attractive or enhancing brand perception through smart, evocative advertising. Today, as innovation's terrain expands to encompass human-centered processes and services as well as products, companies are asking designers to create ideas rather than to simply dress them up. Brown, the CEO and president of the innovation and design firm IDEO, is a leading proponent of design thinking - a method of meeting people's needs and desires in a technologically feasible and strategically viable way. [1]It blends an end-user focus with multidisciplinary collaboration and iterative improvement to produce innovative products, systems, and services. Design Thinking creates a vibrant interactive environment that promotes learning through rapid conceptual prototyping [2], and problem solving approach that focuses on people and their emotional responses. [3]Injecting design thinking into the organization's DNA is the secret to a long-term, sustainable innovation mind-set. SAP has adapted the methodology to fit both the customers' needs and internal needs, and has been evolving design thinking for use on the shop floor, the IT suite, the C-suite, and even the board of directors' suite. [4] SAP has come up with a Cloud Platform for prototyping named BUILD that allows design thinkers to develop intuitive prototypes based on the user story, engage end-users for feedback and jumpstart design ideas. BUILD is a prototyping tool created by SAP, for you to more easily design and prototype apps. It doesn't require technical expertise, and it's free. It has four primary sets of capabilities. you basically go through a process of learning, getting inspired, creating, and gathering feedback. [6]

II. METHODOLOGY

Sketching user experiences approaches design and design thinking as something distinct that needs to be better understood by both designers and the people with whom they need to work in order to achieve success with new products and systems. [7] Information and knowledge workers as well as other employees who are not part of a research or product development team are barely exposed to innovation creation processes. Design thinking as an innovation method is typically used in research and development and analysis is done whether a short-cycled design thinking method can be developed, so employees outside research and development can be taken out of their daily jobs and innovate without falling too much behind with their operational work. Alongside with short-cycled design thinking session there are potential impacts on business and management. Business thinking barriers are tried to be broken and design thinking advantages are increasingly preferred by management. [8]

2.1 Design Thinking

Design Thinking is a methodology that provides a solution-based approach to solving problems and welcomes the multi-dimensionality of a dynamic process and one has the liberty to juggle the stages in a manner that complies their workflow or

turn the thinking process awesome. The process brings out more ideas and refers more choices. The design thinking process is more of a diverging and converging process as against the linear innovation process.

The sequence of five step iterative process in design thinking is summarized as follows,

1. Empathize
2. Define
3. Ideate
4. Prototype
5. Test

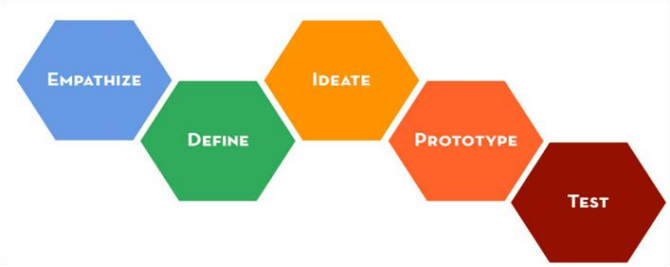

Fig 2.1 Design thinking five step Iterative process

Step 1 - Empathize

Empathy is the centerpiece of a human-centered design process. The Empathize mode is the work done to understand people, within the context of the design challenge. Effort to understand the way user does certain things and why, their physical and emotional needs, how they think about world, and what is meaningful to them. [5] Story mapping is a technique that allows you to organize your user research and breaks down your findings. So there are basically three ways to empathize with user. The first is immerse, meaning become the user and actually live their experiences. Then there is the way of observing user. People-watching is always fun, but observing is about seeing user's actions and understanding why they are acting in a certain way. And then lastly, actively engage with users –meaning actually talking to them. Engage in conversations, which allows the user to tell stories of their own experience. When moving from gaining empathy to draw conclusions from the research, all the things heard and saw needs to be processed to understand the big picture. [6]

Step 2 - Define

In this phase, a persona, user journey, and point of view is defined based on user research. Personas put a personal human face on otherwise abstract data. When creating persona, characteristics like job, activity, needs and pain points that user is facing needs attention. The next step is to create a User Journey that provides a sequence of actions, touch points, mindsets, and feelings the users are involved in as part of their journey. Finally, the last step is the point of view, which is a statement that exists from user, his need and why. [6]

Step 3 – Ideate

Ideate is the mode of the design process in which the designer concentrate on idea generation. Mentally it represents a process of "going wide" in terms of concepts and outcomes. Ideation provides both the fuel and also the source material for building prototypes and getting innovative solutions into the hands of users. [5]

Step 4 - Prototype

Prototyping is the iterative generation of artifacts intended to answer questions that get you closer to your final solution. [6] A prototype is an opportunity to have another, directed conversation with a user. A prototype can be anything that a user can interact with – be it a wall of post-it notes, a gadget put together, a role-playing activity, or even a storyboard. Ideally it is a designer's bias toward something a user can experience. [5]

Step 5 - Testing

Testing is the mode in which the low-resolution artifacts are put into practice by placing the prototype in the appropriate context, [6] and you solicit feedback from your users to gain empathy for the people you are designing. [5]

III. PROBLEM DESCRIPTION

The monitoring and nurturing of vegetative produce from being looted or destroyed by external forces like intruders and wild animals is need of the hour for farmers. The user considered for analysis is M/s Kootangari Estates a small grower farming entity with agricultural produce spread over 10 acres with spices and cash crops. The existing farm is far from the user's residence and due to health issues an effective monitoring of produce, labor or intruders who either destroy or steal the crops is not achieved. An attempt has been made to implement the design thinking methodology to prototype an intuitive application using SAP BUILD.

3.1 Design Thinking

The Design Thinking sequence of steps are as follows,

3.1.1 Empathize:

The Empathize mode is the work done to understand the user's requirements by actually immersing, observing and actively engaging with them. The user's daily routine along with his activities were recorded after field visits and interviews and a few are presented in story map.

Story Map

Defining words	**Thoughts & Beliefs**
• Needs to monitor and effectively view produce / workers through a bird's eye view • Mechanism to alert the supervisor or user	• Farm Produce not up to the mark • Laborers and supervisor attendance and working hours are not accurate but due to scarcity of labor not able to take step further

when something unusual is detected in farm	
Actions & Behaviors • Travels 45 Kilometers weekly to monitor the farm • Unable to walk through the entire farm and gets update from supervisor	**Feeling and Emotions** • Ancestral farm and don't have plans to sell it. • Children settled abroad and want user also with them • Farm produce being spoilt by wild animals, stolen by intruders and forest fire issues

Fig 3.1 story map of user – M/s Kootangari Estates

3.1.2 Define:

Define phase consists of a persona, user journey, and point of view based on user research in Empathy phase. Persona describes characteristics of users like job, activity, needs and pain points. User Journey provides a sequence of actions, touch points, mindsets, and feelings the users are involved in as part of their journey. Point of view is a statement that exists from user, his need and why he needs the specific points to be emphasized.

Persona

Owners of M/s Kootangari Estates would like to remotely monitor with a 360-degree view on all day activities with metrics on daily labor and farm produce using a mobile application. They also want to capture images and videos of Trespassers, who enter their farm and to ensure safety and protection in all aspects, the watchtower is connected 24 hours and 7 days to Police, Fire station with Forest Department.

The Needs, Main Goals and Pain Points of user are precisely summarized below

Needs

- Plan Resource Allocation on daily basis
- Updating Daily Farm Produce
- Review of live video footages

Main Goals

- Auto Inform and alert Trespassers to Owners/ Security and,

1. Police, in case of humans

2. Forest department, in case of wild animals

3. Fire Service department, in case of fire / forest fire

- Review of Complaint status for trespassers with government officials

Pain Points

- Stealing of farm produce in large quantity by trespassers
- Unable to trace the exact person / animal
- Under-utilized Labor resource
- Unable to frequently monitor a large area by manual means
- Unable to walk through steep areas of Estates

User Journey Map

ACTIONS	Owner visits estate on daily basis	Check for no of Labors working	Take a tour around the estate by walk	Check for any intrusion by means of Human / animals	Return back to starting point and check the farm produce and pay daily wages
MINDSET	Should I waste my time and money coming everyday ?	Am I extracting work for what I pay?	My knee starts to pain! After the steep walkthro ugh	Happy if nothing found, but not convince d	Not sure if that's the exact farm produce or someone stole a part of it
FEELING	Bad ☹	Neutral	Bad ☹	Neutral	Bad ☹
FEELING	Good ☺	Good ☺	Good ☺	Neutral	Neutral
TOUCH POINTS	Weekly / monthly visit	Labor finger print scanner/ face detection	Travel by Horse through steep path	Provide electric fencing / Cameras	Transfer money online to pay wages

Fig 3.2 User Journey Map

Point of View

The user, his need and the ask are precisely summarized below,

User - Owners of M/s Kootangari Estates

Need - To monitor their estate produce, trespassers, daily labor schedule, labor wages / attendance, complaint status on Intruders over his mobile phone.

Why - To reduce the non-value added time he spends and to have better utilization of resources and satisfaction in terms of safety and reliability of the estate and also profit

3.1.3 Ideate

Based on the data collected in the empathy and define phase, a brainstorming session happens to finally kick off the possible solutions, before ideas are transformed into a physical form.

3.1.4 Prototype

An attempt has been made to prototype through SAP BUILD online which saves paper and time, unlike the conventional methods that use post it notes and charts.

3.1.5 Test

The testing phase involves the user with hands on the prototype to identify, if his thoughts described are visualized and if the prototype fulfils his expectations and requirements.

IV. RESULTS ANALYSIS AND DISCUSSIONS

Design thinking methodology is used to capture the user's requirements and SAP BUILD is used to prototype suit the user needs. A mobile based prototype application is developed for the user to have a real-time view of his farm with a tower monitoring system which updates the daily labor data and farm produce which will be sensor based. There are IR based cameras which monitor the intruders all day and anything suspicious is reported with images to either the Forest, Police or Fire Service. The real-time analytics and historical data of the farm can be viewed and downloaded in the form of Pdf or Excel files. An option is also enabled to store captured images over the cloud. Tower alert option is enabled for the user to alert the workers in case of a forest fires or any unusual happenings in the farm detected over the video. The prototype can be viewed and navigated through the link provided with a free sign up.

SAP BUILD Prototype Application Website Link: https://www.build.me/projects/eyj0zw5hbnqioijzdgfuzgfyzcisinbyb2ply3rjzci6ija5zjq5yjaxndq1yzdimmiwzwqwmznmyij9

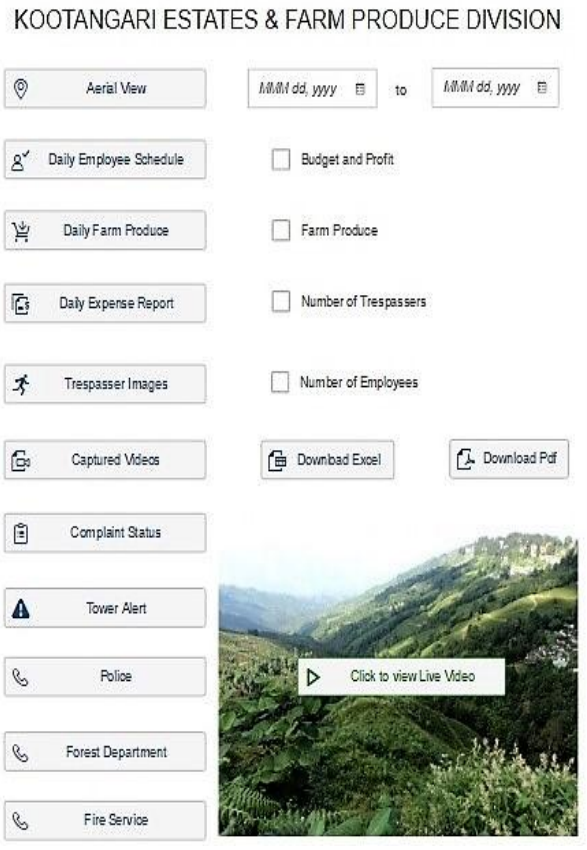

Fig 4.1 Application Main Page

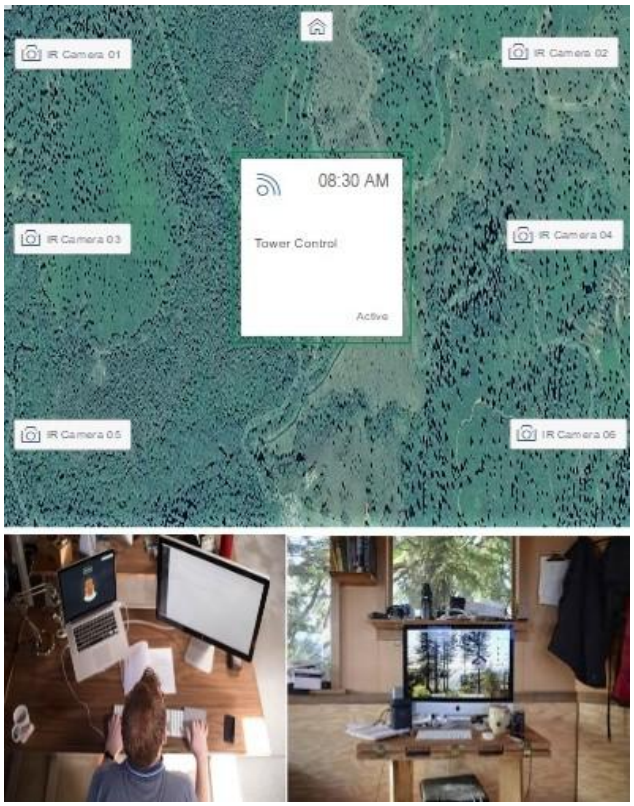

Fig 4.2 Aerial View Page

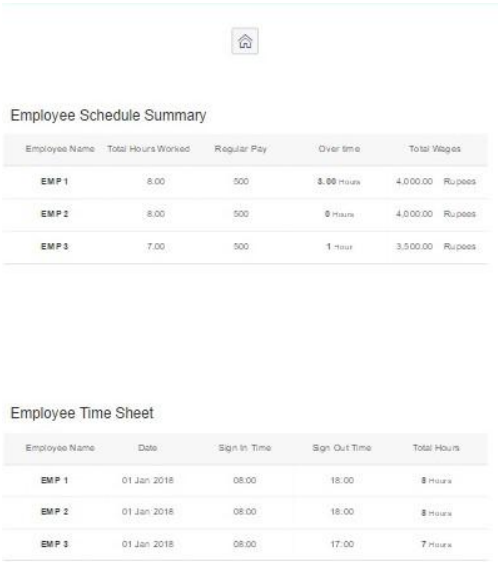

Fig 4.3 Daily Employee Schedule

Fig 4.4 Daily Farm Produce

Fig 4.5 Daily Expense Report

V. CONCLUSION

In this paper an attempt has been made to use the design thinking methodology along with SAP BUILD software to design a lean prototype without use of any physical materials. The prototype is based on user requirements along with problem identification tools like story map and user journey map to drill down towards the core design. Through this design thinking methodology, we are happy to act as minor drivers for agriculturists to shift towards a flexible and digital organizational structure that will save at least some agricultural lands from becoming concrete jungles and be available for the next few generations. The future research of this paper aims to integrate SAP based Internet of Things functionality in conjugation with this application in a practical environment, which will be an automated solution with voice control devices.

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